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Popular Science

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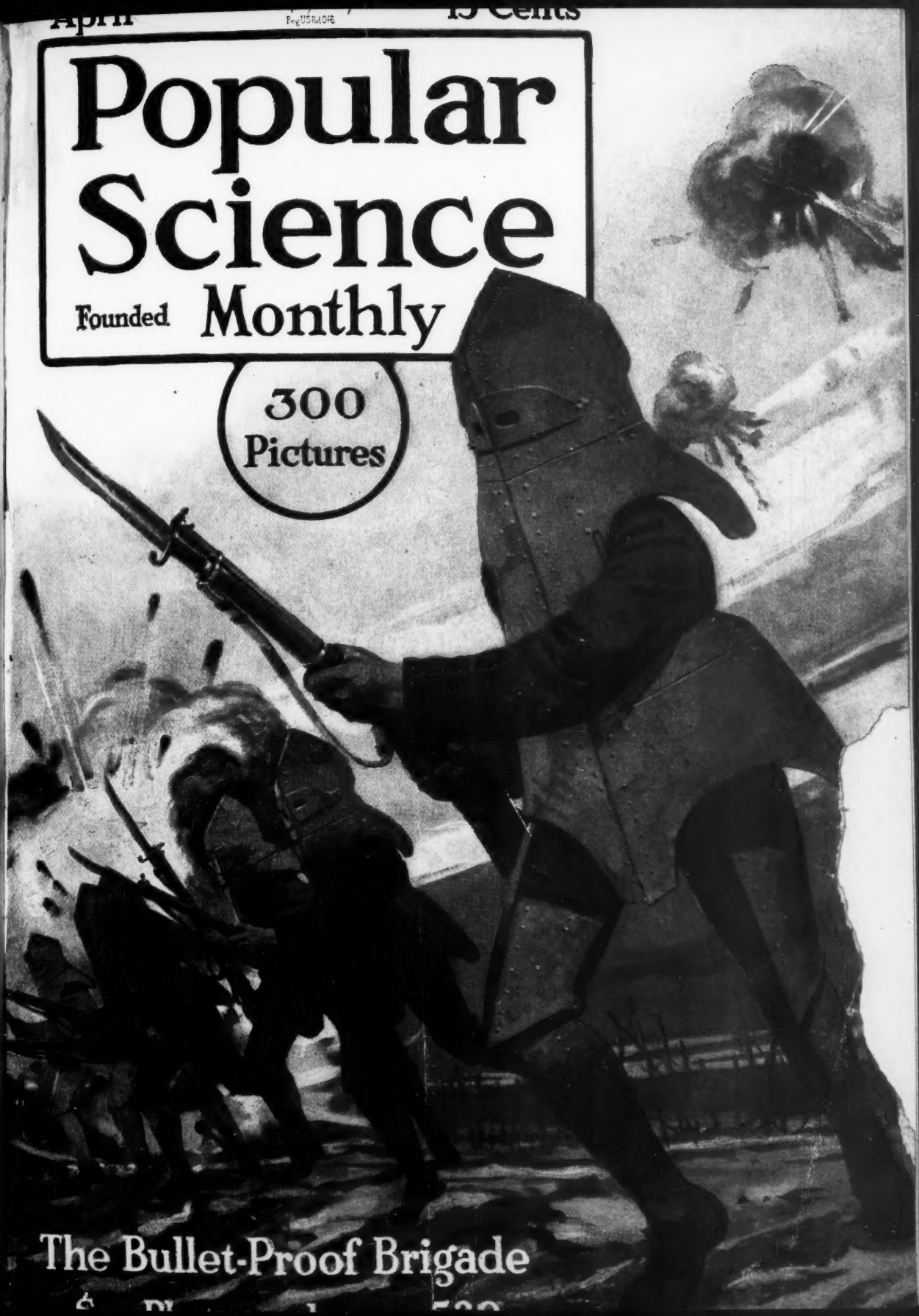

The Bullet-Proof Brigade

Photo White

Oscar Saenger

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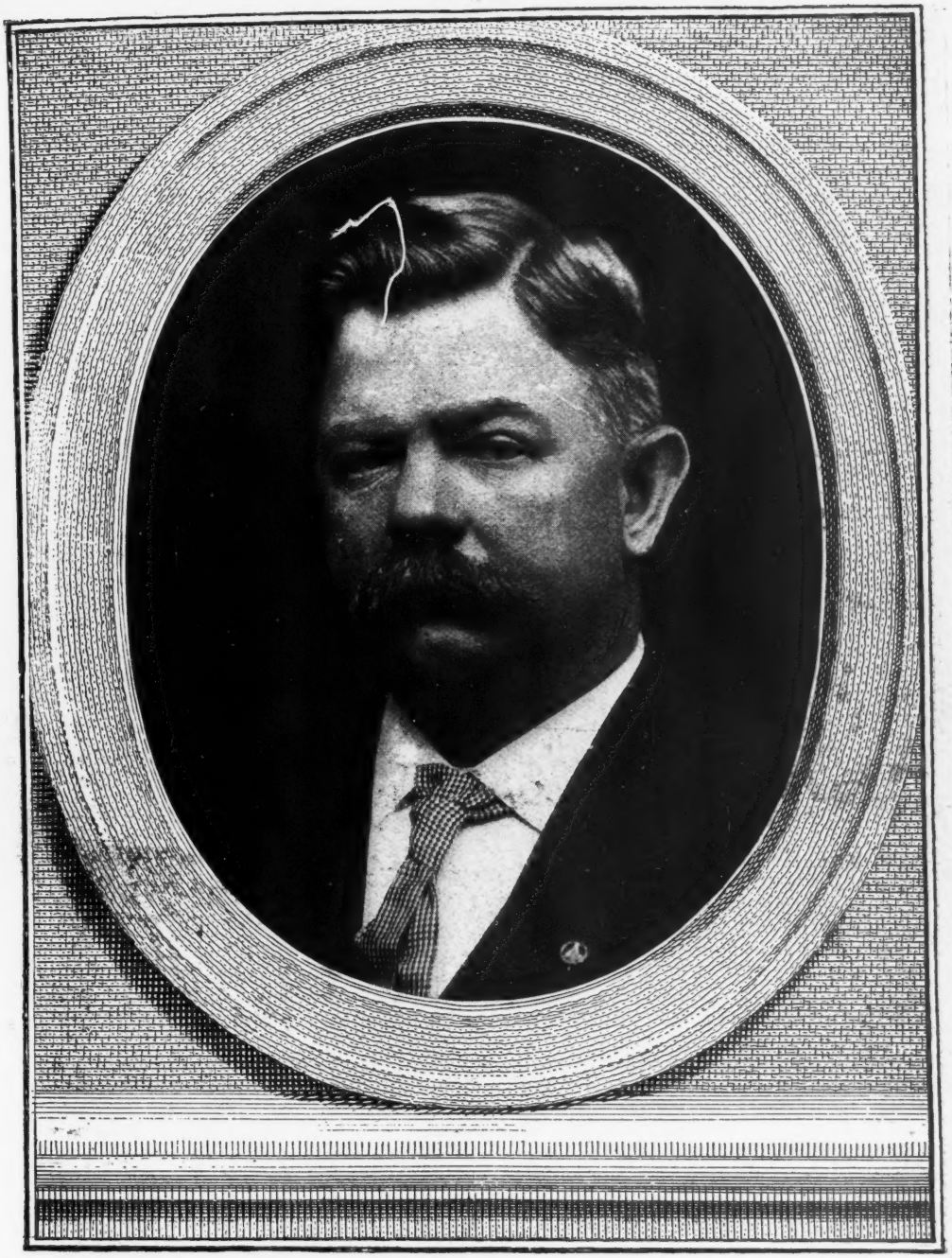
Simon Lake, Inventor of Submarines



"To students of Natural Philosophy, Science or the Arts of Mechanics, Chemistry, Navigation and, in fact, new things of general interest to every thinking person who lives in this, the greatest age of scientific advancement, The POPULAR SCIENCE MONTHLY is a boon, and it is "on its job" of giving first information to its readers of the many new and interesting things now being developed."

Simon Lake

The Life-and-Death Struggle on the Monster's Back

"The wounded devil-fish kept plunging below, then throwing herself half out of the water, and as she followed these maneuvers by short rushes on the surface, accompanied by violent blows, I quickly realized that the safest place for the boat was on the fish's back. The fish was always kept near, and for twenty-two minutes, we had possibly the most dangerous fight ever fought successfully on the water with any living creature. The monster's mate was an additional danger."

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Fighting the Terrible Devilfish

The story of a thrilling hunt conducted in the interest of science

THE American Museum of Natural History wanted to secure a big specimen of a devilfish (called by naturalists *Manta birostris*) and Mr. Russel J. Coles undertook to obtain that specimen at his own expense. He is probably the most skilful hunter of the devilfish in the United States of America. We are indebted to him and to the American Museum of Natural History for the material on which the following article and the accompanying drawings are based.

The devilfish is the largest of all the fish known as rays. It owes its name to its appearance—an appearance given by a pair of flaps or feelers, one at either side of the mouth to help in feeding.

Mr. Coles decided that ordinary methods would not do. He says:

"I found that both sharks and rays sometimes continue fighting long after both brain and heart have been pierced by lance and bullet, but that death is instantaneous when the spinal cord is severed at a certain spot just back of the brain. . . . I therefore designed and had forged a huge lance, more than three times as heavy as a whale lance, which I call a 'spade lance' on account of its having a square cutting edge four inches wide."

A devilfish once towed a 100-ton vessel far out to sea, and the crew had to cut the rope and let the creature escape. In view of the creature's strength, Mr. Coles decided that he would have to invent some way of bringing the devilfish to close quarters as soon after harpooning it as possible. To this end he designed a drogue, or dray for offering the greatest possible resistance to a pull. In his account Mr. Coles says:

"I also carried a very powerful repeating rifle and a large shoulder whale gun, from which either a harpoon, or a bomb lance containing half a pound of powder, can be fired. . . ."

In securing his specimen for the American Museum of Natural History, Mr. Coles had with him, in addition to Captain Charlie Willis, the best known and most efficient fisherman on the Florida coast, Captain Jack McCann, who selected the three other members of the crew—all young men, trained, active and without fear. Captain McCann also furnished the boat which was a small twenty-six-foot open boat with an eight-horsepower gasoline engine.

In killing a devilfish it is necessary for every man to move instantly when the word is given, like part of a perfect machine. The procedure is thus described:

"Charlie Willis stands forward with me to throw the auxiliary harpoon; Captain Jack McCann steers the boat; another man stands just behind me to throw the drogue overboard as the harpoon leaves my hand, and to give me my spade lance; the next man runs the gasoline engine, while the last stands ready with a bucket to bale water should this become necessary. All, including myself, are ready at a word to throw their weight on the high side of the boat if it should begin to turn over."

After the long fight, it took ten hours to tow the big fish to shore. The "horns" on each side of the huge mouth are here rolled up. The instinct of the animal is to clasp these horns around any object that bars progress. A blow from one of the huge fins is likely to sink a boat

The first encounter with a devilfish came suddenly with a most terrific shock which threw the four men who were standing, to their hands and knees.

"The boat, which was running at full speed, had met the head of a *Manta*, rising to the surface and coming toward us at moderate speed. The shock of the collision was so great that it almost stopped the headway of the boat, and its bow was lifted more than a foot out of the water; but our speed carried the boat up over the high part of the back of the *Manta* just as the two great black fins were flung madly into the air, almost meeting over our heads and deluging us with many gallons of water. Then the two fins crashed down on the surface of the sea with a noise that could have been heard for miles, and the *Manta* instantly repeated the performance as I yelled to the engineer, 'Keep her going.' Just as the boat was sliding from the back of the creature, another huge *Manta* rushed up from below, striking full on the port bow with sufficient force to spin the boat around until its direction was almost reversed. At one time all four of the great black pectoral fins were towering above the men in the boat, and large quantities of water were flung into the bottom. First the head and then the stern of the boat was highest as it was pitched from side to side, and then the chug, chug, chug of the racing propeller blades could be heard as they gashed the tip of the pectoral fin of the first *Manta*. The engineer kept the engine going at full speed, but the propeller blades were not catching the water, and for a short distance the boat was carried upon the broad backs of the two monster devils of the sea.

It is possible to kill one of these monsters with Mr. Coles' specially devised spade lance by a single well-aimed thrust just severing the spine back of the brain

"Scarcely a word was spoken until, in the midst of a wild upheaval of the two madly frightened *Manta* beneath us, the boat was flung from their backs and was turning over, when I shouted, 'High side!' which order was instantly obeyed, two of the men, except for an arm and a leg, throwing themselves entirely out of the boat.

"The boat struck head first and shipped a lot of water over her bow, but we were now clear of the two *Manta*, who raced together on the surface for a short distance."

Almost in an instant the boat was cleared of surplus water, harpoon and ropes were rearranged and Mr. Coles and his crew were in pursuit of the two *Manta*, when suddenly the fish went below. In the distance he saw three specimens, but all of them were under thirteen feet in width; then the first two came in sight again, and after that they were seen many times. The first showed the bleeding fin tip which had been cut by the propeller, and its mate had lost about eight inches from the tip of one of its fins in some former encounter.

"These two *Manta* appeared to have lost all fear of the boat and its occupants; we were many times in touching distance of them and they both passed under the boat several times. The first was a female, well above fifteen feet in width, and I was about to attack it, when I saw, nearly a mile away the largest *Manta* that I have ever seen. It was on the surface so I ran the boat down to it, and never have I wanted to kill any one thing quite as badly as I wanted to kill that great fish, for it was fully twenty-four feet in width and must have weighed not less than twelve thousand pounds. I was uncertain however, as to its gender, and a female was absolutely necessary, also I had only fifteen hundred pounds of plaster of Paris—not enough to cast such a huge beast; but the principal drawback was that we could not tow such a monster with the little launch and there was no other boat in sight."

For more than two hours Mr. Coles and his crew moved among the six devilfish, hoping that some other boat would appear to help in towing the carcass of the big one. None came and finally Coles decided to kill the first into which he had run.

"We moved to the attack. As she was passing, quartering across our bow, I gave the word. Charlie and I drove our harpoons deep into her broad back; then, with a great splash of her fins, she plunged below and ahead. As the drogue was snatched under, it threw water high in the air and the shock was so great that it brought the great ray to the surface in that awkward, wheeling, edgewise leap that *Manta* make, after the manner of a wheel turning over. Before its tail had reached the perpendicular, I and all of my crew saw an embryo, folded in cylindrical form, thrown high in the air, and I heard Captain Jack exclaim, 'Did you see that? The young one has a tail longer than the old one!' The embryo quickly unfolded its fins and, catching the air horizontally, its descent was retarded until after the mother fish had disappeared beneath the surface.

"When I had hurled my harpoon and reached behind me, the spade lance had been instantly placed in my hand, but as I saw this embryo feebly flapping on the surface, I passed back the spade lance and yelled 'Give me an iron, quick!' (the harpoon is always called an iron) and while not five seconds were taken in the exchange, that was too

Modeling the big Coles devilfish in the American Museum of Natural History. The underside of the fish measured eighteen feet from tip to tip of the large fins. The tail of the devilfish is normally about as long as the extreme width of the animal. Rough plaster molds of the upper and under side of Mr. Coles' big devilfish were made on the beach after it had been landed. These were sent to the American Museum in twelve sections and after having been put together were used for the making of a cast. The photograph shows Mr. J. C. Bell at work upon this cast perfecting it in detail. After this another mold was made from the perfect cast and another light cast from the perfect mold. This last cast was colored and the model is a lifelike representation of the great devilfish in every particular. The tail has not yet been put in place on the model shown in the picture

long, for as I threw back my hand to strike, the male swept the embryo beneath the surface with one of its fins.

"I passed back the harpoon and seized the spade lance, as I saw the wounded female, now on the surface, charging down on us at highest speed. I was forced to strike instantly and there was not sufficient time to clear up the line attached to the lance handle, so the point of the spade lance was slightly deflected, with the result that the fatal spot was missed by a few inches. However, the force of the blow, which was delivered with both hands without releasing the handle, was so great, that it depressed the creature's head, and the head-on collision did not crash in the side of the boat as it probably would have done otherwise. The top of the head struck the bottom of the boat, breaking the lance handle short off against the side, and I was confronted with a very serious defect in my equipment. I had acquired, by years of work with the lance, such confidence in my ability to place it where I desired that I had not thought it necessary to provide more than one spade lance; but now my fish was very much alive and fighting mad and I was without a spade lance.

"With this gone the danger was much increased, as the fight had to be carried on with the old-fashioned whale lance, which I had made with the shank only three feet long instead of five or six feet as in the lances used on whales. The big drogue kept the fish always near, and we had possibly the most dangerous fight ever fought out successfully on the water with any living creature. The wounded devilfish kept plunging below, then throwing herself half out of the water, and as she followed these maneuvers by short rushes on the surface, accompanied by violent blows, I quickly realized that the safest place for the boat was on the fish's back, and I directed accordingly."

The water was so thick that the devilfish could not be seen until very near the surface, but the slack of the harpoon was kept hauled in and the line showed the direction in which the fish was traveling under water. So well was the boat handled by the helmsman (Captain Jack McCann) that not once in more than a dozen rushes did the devilfish reach the surface without finding the boat on her back. Each time Coles drove the lance to her heart or brain one or more times, and after the fight she showed twenty-three wounds. No attempt was made to use the Winchester rifle or the big whale gun. This Mr. Coles attributes to every man's lust for blood in a fight. The blade is more satisfying than the gun.

The dying *Manta* finally gave up the ghost with a loud harsh bark or cough.

The Life-Preserver Chair Cushion

A new idea for pleasure yachts and steamers

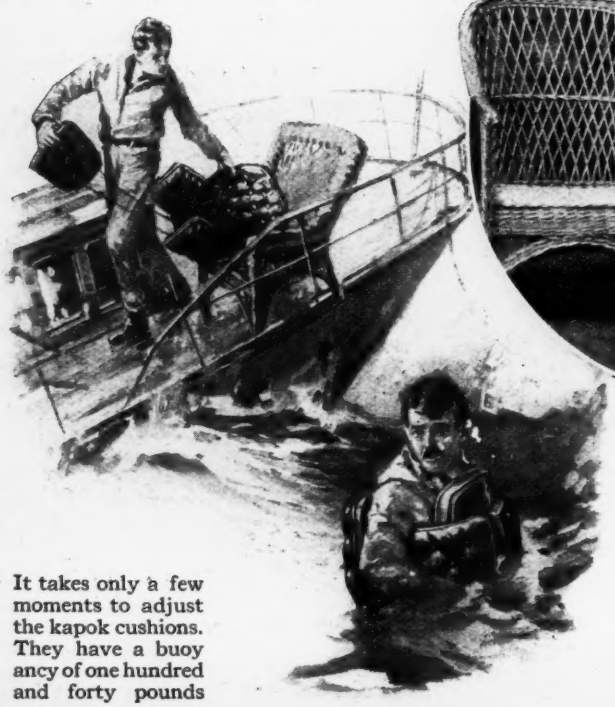
The chair cushions in position on the body as a life-preserver

WHEN next your best friend invites you to take a trip on his yacht, do not refuse just because you do not happen to see anything that looks like a life-preserver around. He may have fitted out his deck chairs with life-preservers that serve as cushions. Practically everything that is upholstered can be made into a life-preserver. The mattress you sleep on at night, the pillow under your head and the deck chairs in which you lounge during the day all can be designed to float and help you float if disaster overtakes the ship.

The most interesting of these life-preservers is contained in the easy chairs which invite you to rest on the deck. The comfortable leather upholstery may be removed from the chair in a minute and fitted on a person as a life-preserver. When the time to take to the water arrives, you simply rise from your chair, grasp the cushion which has been supporting your back and raise it up. You will see that it is attached by two straps to the cushion which forms the seat. Lift the cushion over your head so the two straps rest on your shoulders and the seat lies on your chest. Two other straps attached to the cushion and the seat are readily adjusted so the life-preserver fits you correctly whether you happen to be stout or thin. The straps fasten with snappers and you may hook yourself into the life-preserver with all the expedition with which a fire-horse gets into his harness.

The seat and back cushions are connected with two straps. The seat fits over the chest

The material used in this type of marine upholstery is kapok from Java. This will not absorb water and is exceedingly buoyant. It is equally attractive for the purpose of ordinary deck upholstery as real leather, which it very closely resembles. The chair cushion life-preserver has a buoyancy of one hundred and forty pounds while the ordinary life-preserver only boasts about twenty-seven pounds buoyancy.

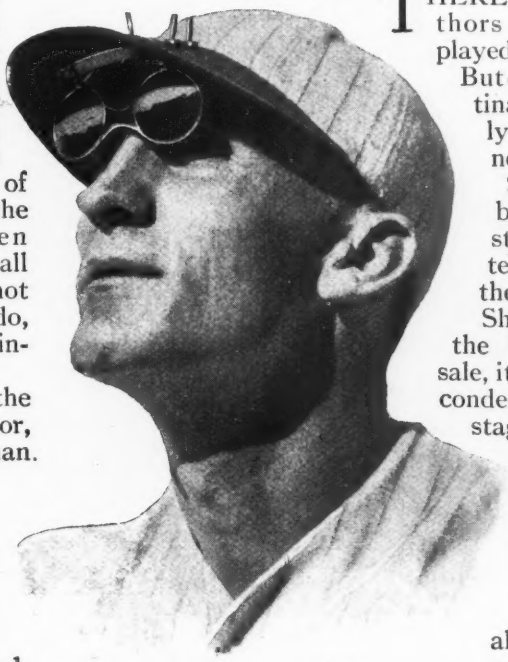


It takes only a few moments to adjust the kapok cushions. They have a buoyancy of one hundred and forty pounds

Sun-Glasses—A Sure Antidote for the Baseball Muffer

MANY a baseball game has been lost because an outfielder muffed a fly ball when the sun got in his eyes; and many a baseball player has had to bear up under sharp criticism at the hands of angry spectators when the sun should have been blamed. Catching a ball against a blinding sun is not only a difficult thing to do, but it is extremely injurious to the eyes.

If they live up to the claims of their inventor, who is none other than Fred Clarke, veteran Pirate manager, the glasses illustrated will enable the player to catch flies in the face of the strongest sun. The glasses are riveted to the peak of the cap and work on a hinge. When not needed to shield the eyes, they rest against the cap.



With the new glasses to shield his eyes, the outfielder can "pull" a fly down from the clouds directly in the face of a blinding sun

When a ball is hit the fielder simply touches the rim of the glasses and they fall down in front of the eyes in just the proper position so that he has a chance to see the approaching ball even though he is looking directly at the sun. The glasses can not fall off, and they can be shifted out of the way with the quickest kind of a movement when not wanted—two advantages which make them far superior to the old style of "specks."

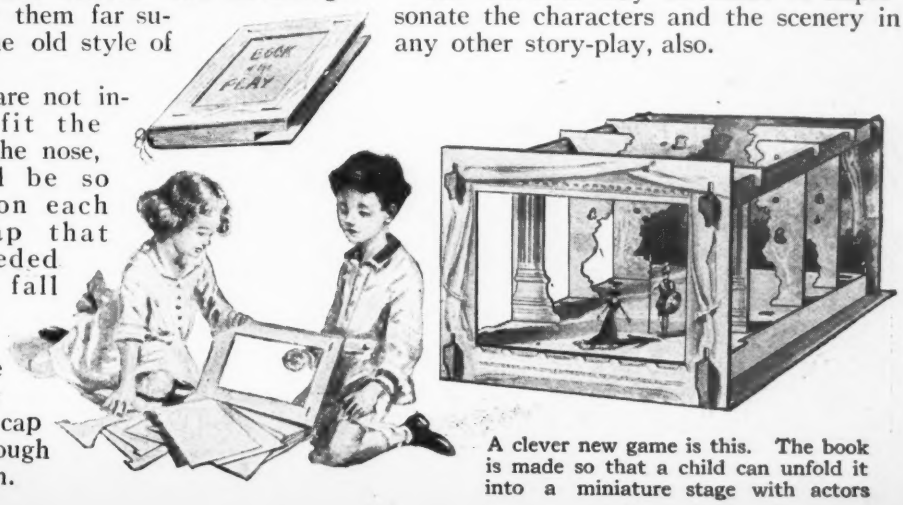
As they are not intended to fit the bridge of the nose, they should be so arranged on each wearer's cap that when needed they will fall exactly in front of the eyes. The peak of any lightweight cap is strong enough to hold them.

The Book Theater. Open It and You Have Actors and a Stage

THERE are not many authors whose books are played upon the stage. But one authoress, Christina Catrevas of Brooklyn, New York, will not be one of them. She has developed a book which is itself a stage while the contents of the book form the actors.

She explains that when the book is placed on sale, it is folded up so as to condense in it both the stage and the actors. On the front cover the title of the play is printed, just as on other books. When the book is brought home it is opened up, and after a few alterations are made a miniature stage is formed as shown in the illustration. The actors are then made like ordinary cut-outs, for the contents of the original book consisted of gayly colored figures printed on its light cardboard "pages." These cut-out figures represent the various characters of the play that is written on the cover of the original book; and when they are ready, the play may proceed in whatever way the imagination of the child dictates.

The cut-outs may be made to impersonate the characters and the scenery in any other story-play, also.



A clever new game is this. The book is made so that a child can unfold it into a miniature stage with actors

Cross-Country Golf—The Surrounding Landscape

A perfectly good course as cross-country golf goes! Instead of chasing your ball three and a half miles on a regular greensward you pursue it the same distance over swamps, through farmyards and what not

Now and then a railroad track gets in the way. The idea is to get the ball over the tracks before the train comes—in other words, not to spend too much time between trains lest the ball escape

Photos by Edwin Levick

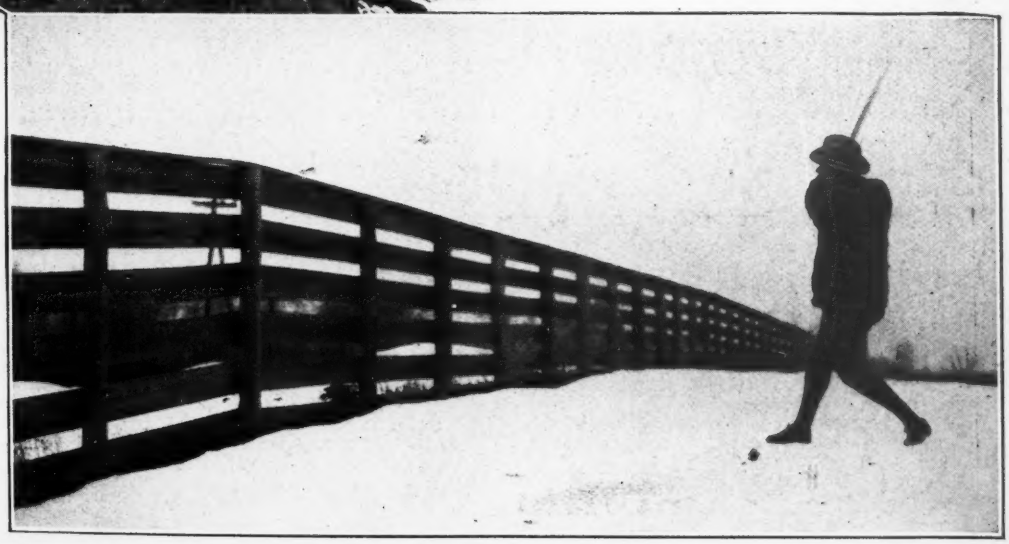
The height of good fortune in cross-country golf—a level spot from which to drive off. The game plays havoc with golf balls, which are more often lost than found over the unfamiliar cross-country

Takes the Punishment and the Players the Prizes

Ah! not so bad! The caddy is trying to follow the ball's flight as it dodges through a young forest. He doesn't know whether he will have to climb a slippery elm to recover it or not

'Way down yonder in the corn field—considered to be a very poor golf course by the best players. It's a lucky thing for the farmer that he cut his corn beforehand

A little thing like a windbreak doesn't bother the devotee of the cross-country game. The thing which does peeve him is to waste three strokes at it



One Unwelcome Way of Greeting Enemy Aeroplanes

To guard the shores of Long Island, New York, against aerial attacks the Government has installed a five hundred million-candle-power searchlight on the aviation field at Hempstead. The light is to be used in co-operation with anti-aircraft guns, to locate and destroy any invading enemy craft

To test the searchlight, aviators will go up in biplanes, followed by "enemy" craft. The huge light will "find" the enemy, after which our aviators will emerge from the darkness and give chase. If any of the enemy escape, our men are supposed to follow them beyond the searchlight radius until they are captured

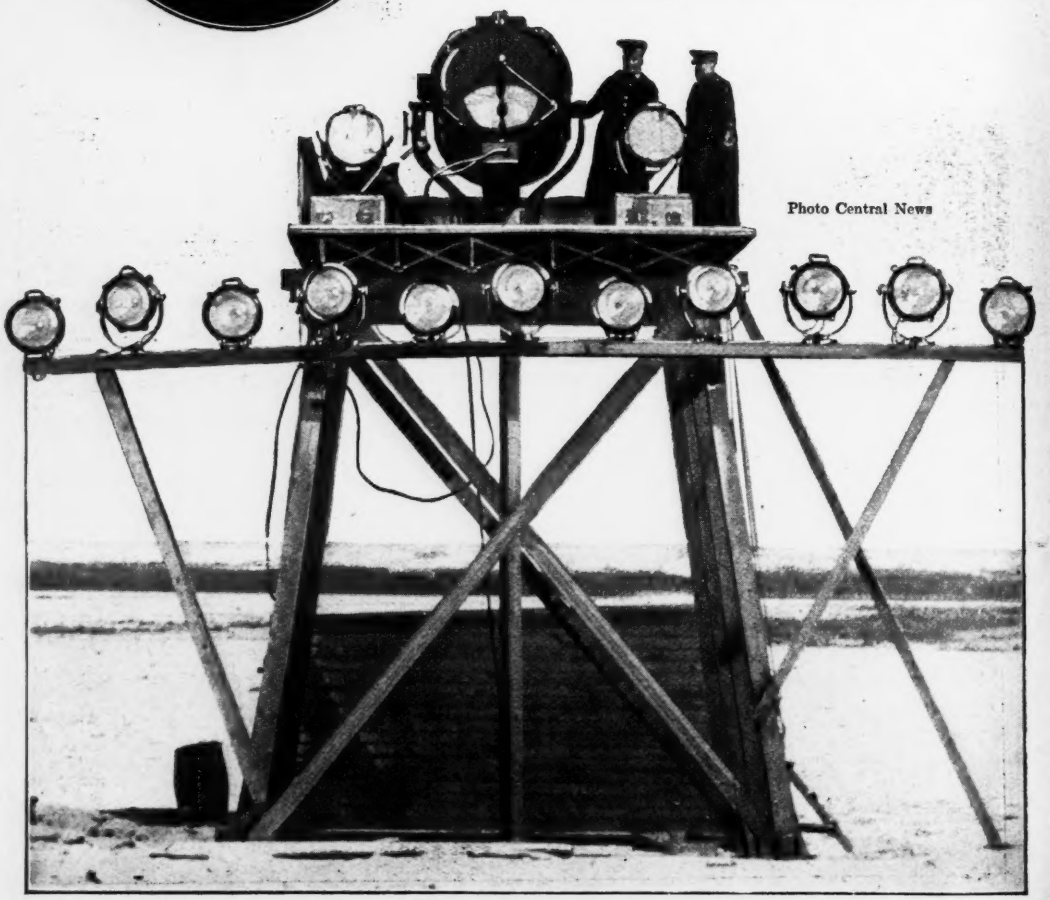


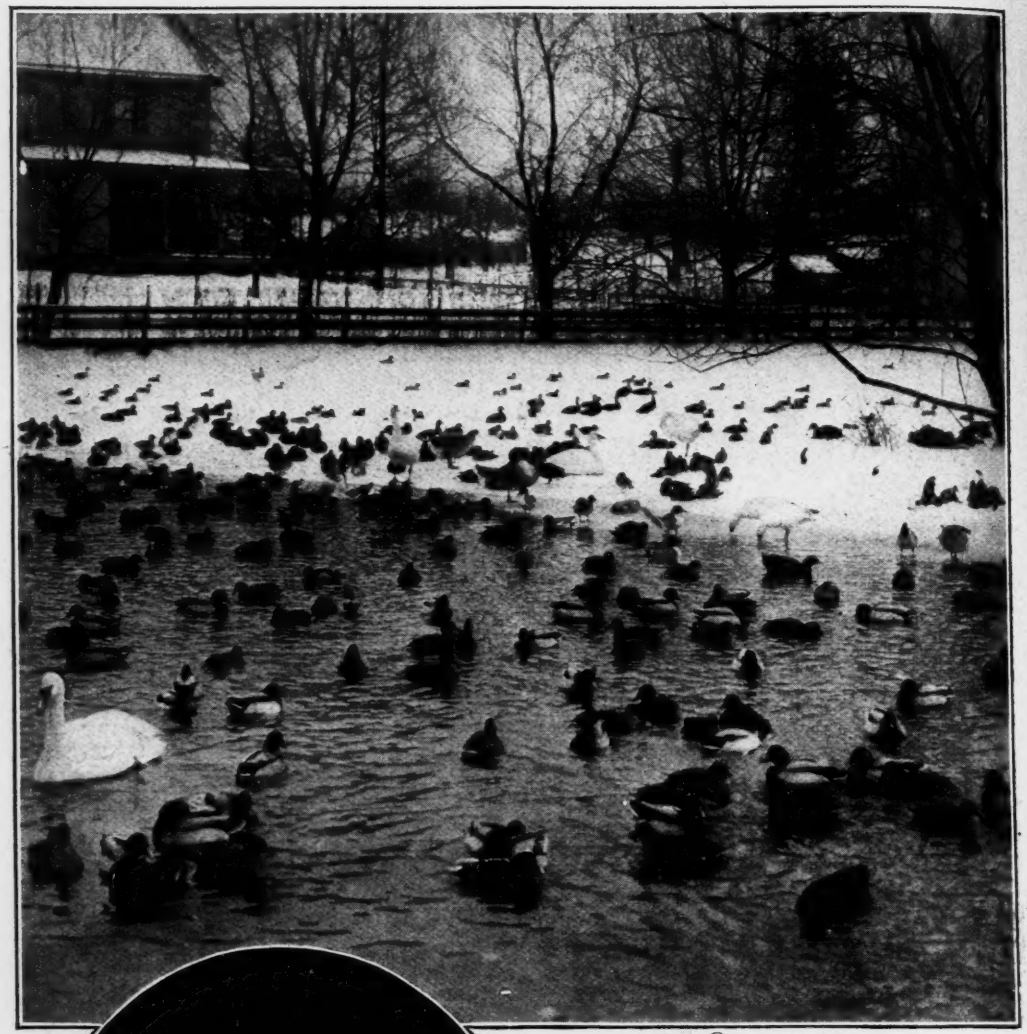
Photo Central News

"Seein' Things" in Slabs of Rock

When Paul Herzel sees a piece of solid rock it suggests to him an animal or a group of animals, and he begins as soon as possible to make the rock take the shape that he has in mind so that everyone may see it as he does. So well does he succeed that he was awarded the Whitney and Barnett prize for animal sculpture at the Academy exhibitions of 1915-1916. Note the expressive faces of the animals and the suggestion of agility and strength brought out in the muscles

Below: Sixteen-year-old Albert T. Stewart, who also dreams dreams and sees visions of animals in the rocks. He is fond of reproducing prehistoric types, and is shown in the photograph at work on the ancient ancestor of the tiger. His model is a very up-to-date specimen in Central Park Zoo, New York city. His models are attracting considerable attention in the art world from critics of note who consider them rich in suggestion, expression, and in accuracy of detail

Birds of All Feathers Flock Together



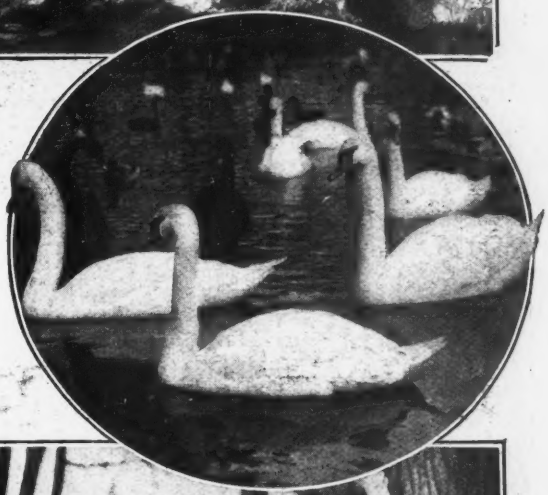
Photos © Brown & Dawson

A paradise for birds at Darien, Connecticut. Ducks mix with pigeons, swans, geese, cranes and all their feathered cousins and live a contented life apart from gunners and poachers. They are bred from purest stock and sold to the owners of private estates

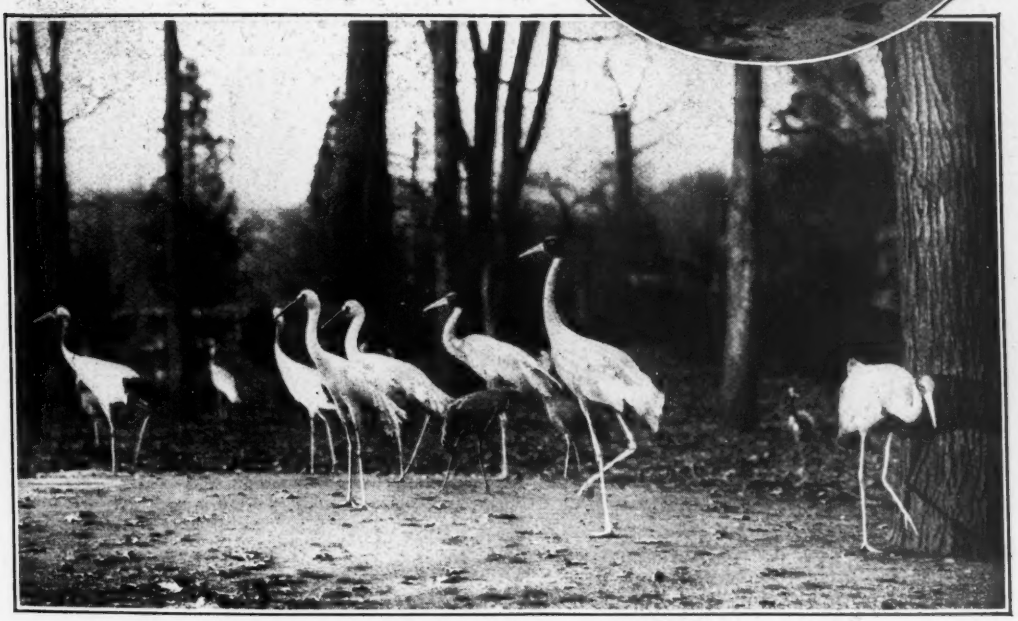
The crown pigeon is an ornamented member of the Darien colony, and by far the proudest. He doesn't associate with the web-foots. There is a steady demand among the collectors for prize birds in the pigeon family

When They Are Not Molested by Man

A community plunge. The birds' wings are clipped so that they cannot fly away. In the swimming melée are ducks of all descriptions and a few haughty swans, milk-white and black

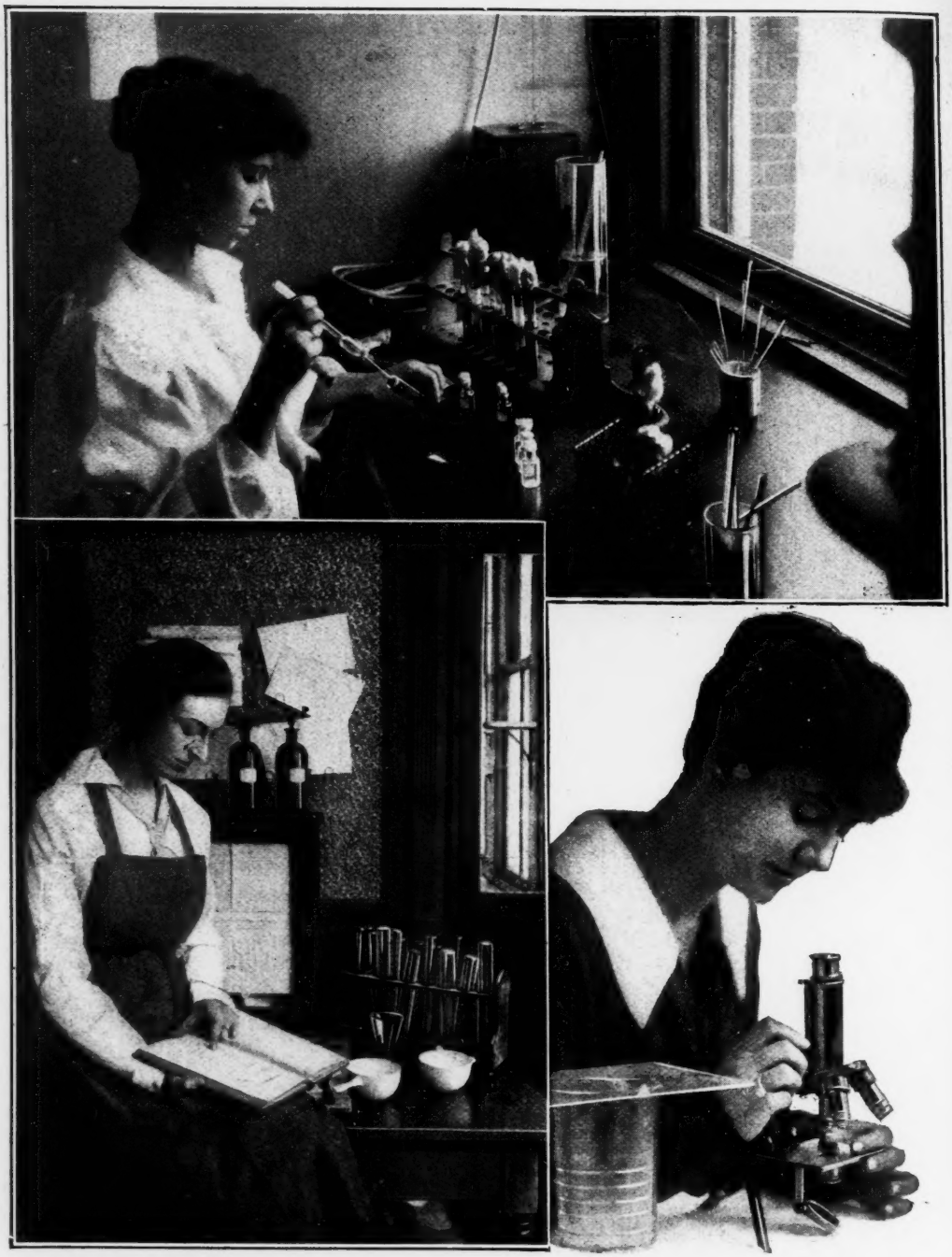


In oval: The mute swan is in the aristocrat class. Although he is rather particular about his surroundings, he is willing to take up an abode almost any place where the food is palatable



The crane lords it over all the others. He is not as popular with the large estate owners as the swan, mainly because he is so destructive. But he is a strong, healthy bird, capable of defending himself, and he is certainly of decided value as a decorative feature

Is Inquisitiveness a Scientific Asset? Perhaps



At top of page: Miss E. L. Valentine, a bacteriologist employed in the laboratories of the New York Board of Health. In the photograph she is shown engaged in the study of the germs of pneumonia and colds which germs have been injected into rabbits

Lower picture at left: Miss Clara Thayer, B. S., at work on water analysis in the Lederle Laboratories, New York City, to ascertain its purity and to determine its possible effect not only upon human health but on the interiors of steam boilers

Louise E. MacRoberts, shown in the lower picture at right, is considered an authority on the mosquito, its sins and the best means for its extermination. She is engaged as an expert parasitologist in connection with the University of California

That's Why Woman Is Advancing in Science

The tapeworm is not the pleasantest animal in the world. Yet Mrs. Edna Watson Bailey has found it an interesting study. She was the first scientist to discover that the much-talked-of microscopic "head" does not exist at all. She is here shown studying the "Chimaera," or angel fish

The Dairy Division of the Department of Agriculture has a competent bacteriologist in the person of Alice C. Evans. She specializes on the study of microscopic organisms and their direct relation to health and to the keeping qualities of dairy products

Dr. Adele Jaffa, of Berkeley, Cal., is an authority on dietetics and a lecturer on the subject. Her planned diets have been followed closely in orphan asylums and in the "Better Babies" campaigns

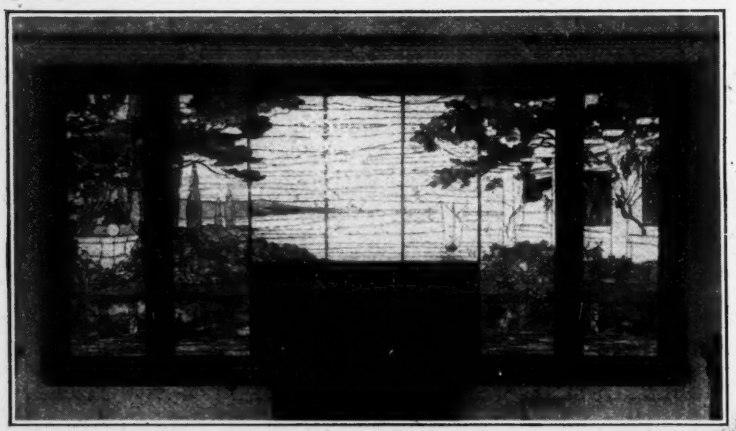
Photos © Press Illustrating Serv.

Miss Anna Maude Lute, scientific assistant in the Department of Agriculture of the University of California, is a specialist on seed analysis and her work is proving invaluable to the farmers

For more than twenty years Mrs. F. W. Patterson has been engaged in studying microscopic forms of life. Her work also comprises study of fungous diseases of plants and the best methods which are applicable for their eradication. Mrs. Patterson is also an authority on mushrooms

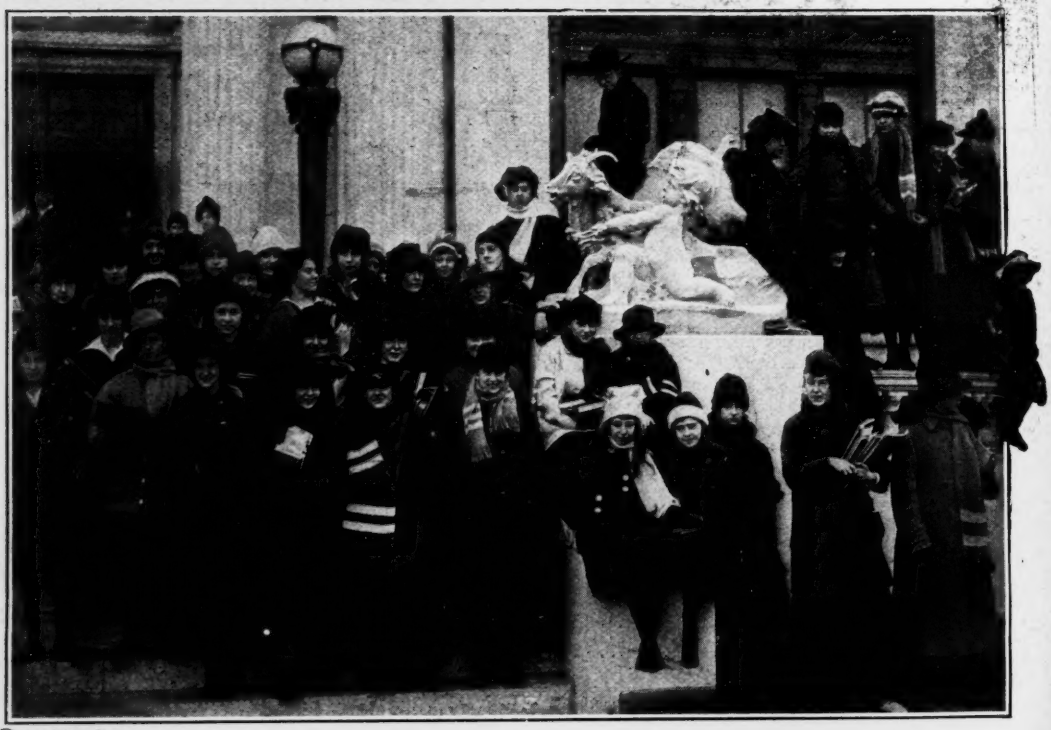
A Million-Dollar School for Seventy-Five Pupils

The High School building of Bristol, R. I., was a gift to the city by Col. Samuel Colt, in memory of his mother. It is of marble throughout, with framework of doors and windows of solid bronze



At left: A stained glass window in the Colt Memorial School, showing the city of Bristol in 1812, when the British were driven out. The seats and chandeliers in the auditorium are also of bronze

The average attendance at this million-dollar school is seventy-five pupils, some of whom are shown below grouped around one of the statues by the famous sculptor Rodin, in front of the building



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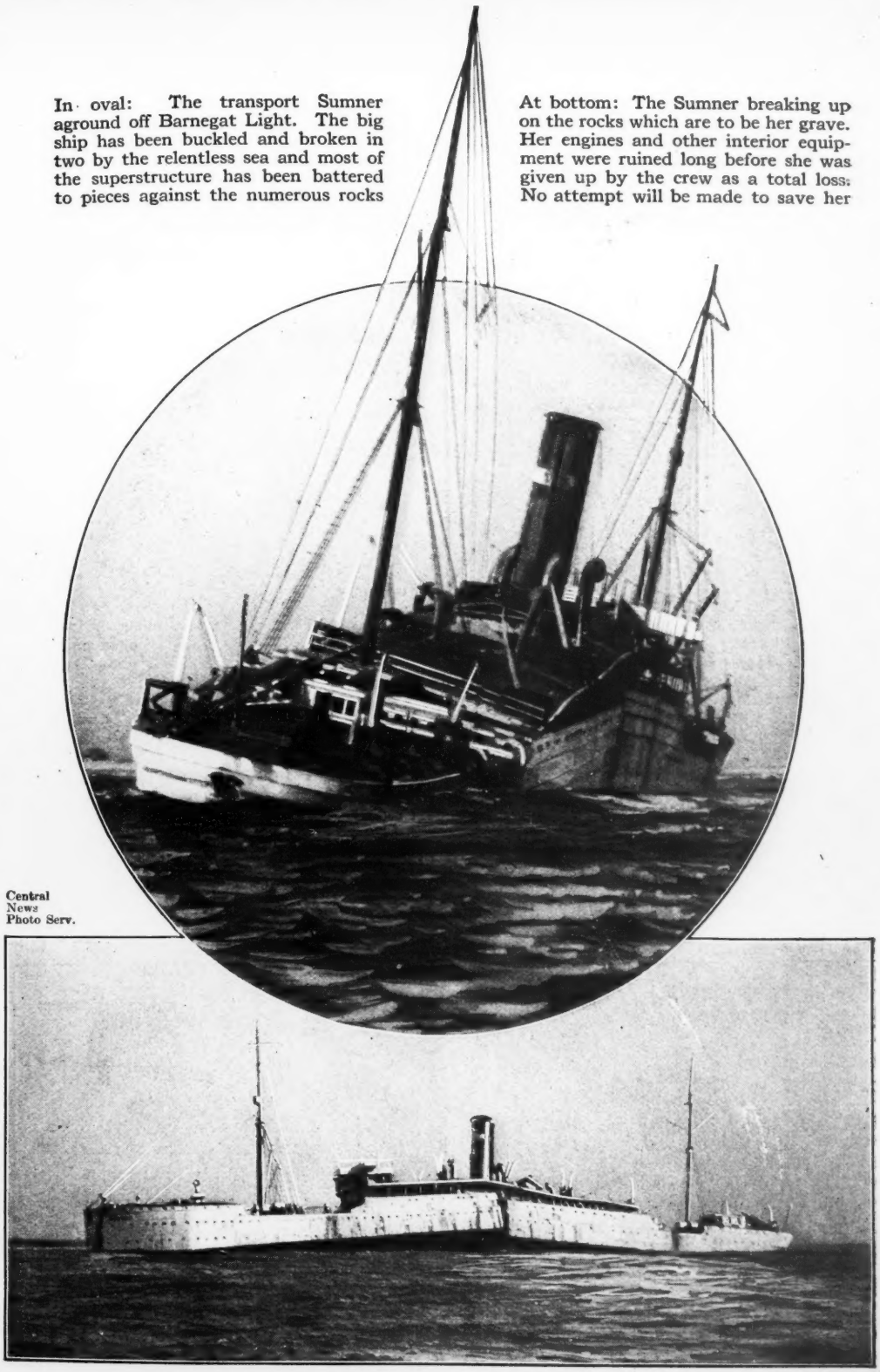
A Transport Victim for Davy Jones's Locker

In oval: The transport Sumner aground off Barnegat Light. The big ship has been buckled and broken in two by the relentless sea and most of the superstructure has been battered to pieces against the numerous rocks

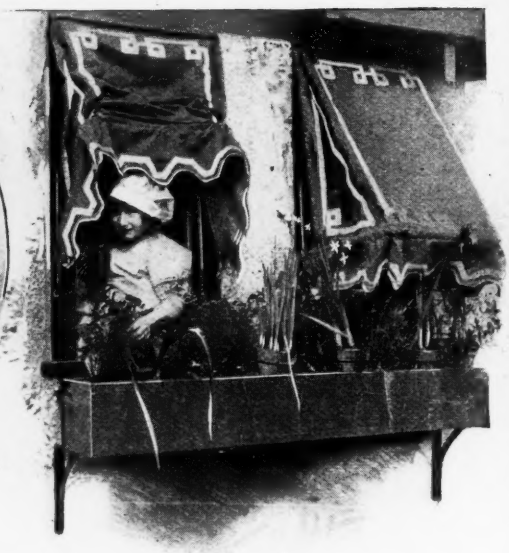
At bottom: The Sumner breaking up on the rocks which are to be her grave. Her engines and other interior equipment were ruined long before she was given up by the crew as a total loss. No attempt will be made to save her



Central News Photo Serv.

A Thousand-Dollar Playhouse for a New Orleans Miss

Young Lothario making love to Theone Hausmann, on the doorstep of her elaborate New Orleans playhouse which is valued at one thousand dollars



A garden at each window and the mistress looking out. The house must be kept clean and the gardens must be tended, so it is not all play for Theone

Below: Theone's coming-out party given in front of her playhouse. Many a New Orleans father is facing an imperious demand for a house like Theone's

At left: The playhouse, which is large enough to be lived in comfortably. Theone spends most of her time there except at night when it is dark

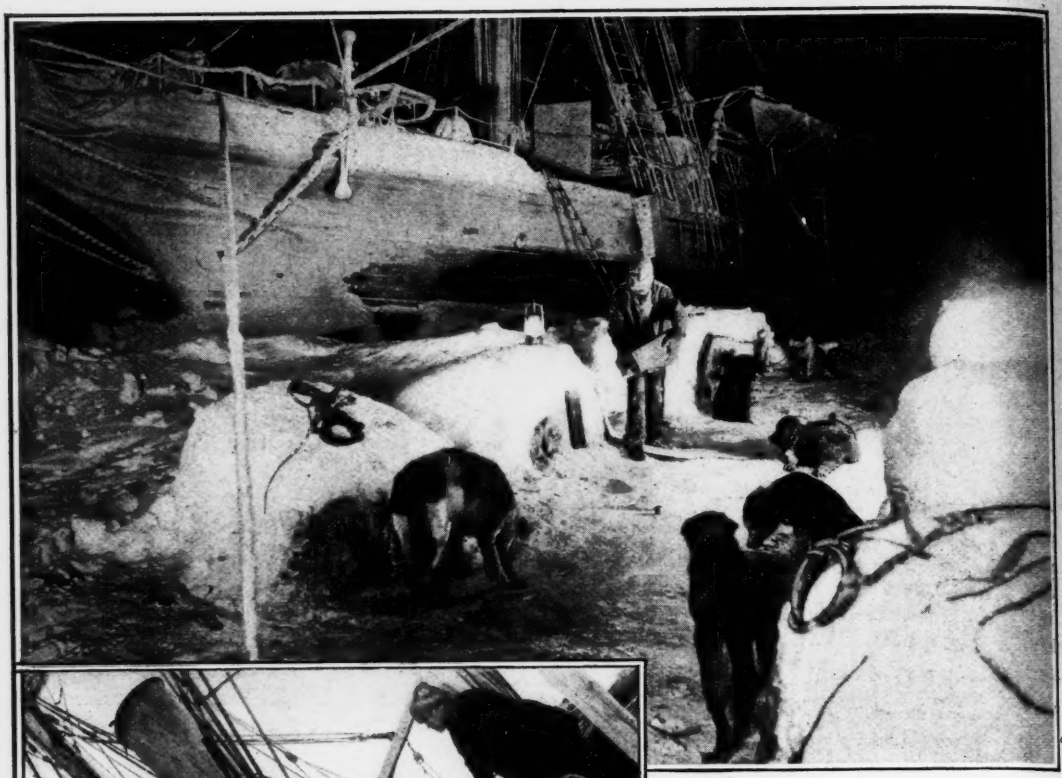
© Int. Film Serv.

Sling-Tennis—Played with a Bean Bag

Sling-tennis, a lacrosse-tennis-bean bag game, is played with a slackly strung racket and an ordinary bean bag. A sling-tennis court is shown above. The top of the net is level with the head of a man of medium height, but it may be lowered for children or as desired

It's a game fast enough for a ranking tennis player and simple enough for little girls in hair-ribbons. The main principle of the game is not striking but catching and throwing or slinging, as in lacrosse. The scoring is almost identical with that employed in tennis

Shackleton's Ship, the Endurance, Going Down in



Bringing food to the dogs, whose kennels are the little snow mounds. Dogs were of little use; for after the ship went down all traveling was done in life boats

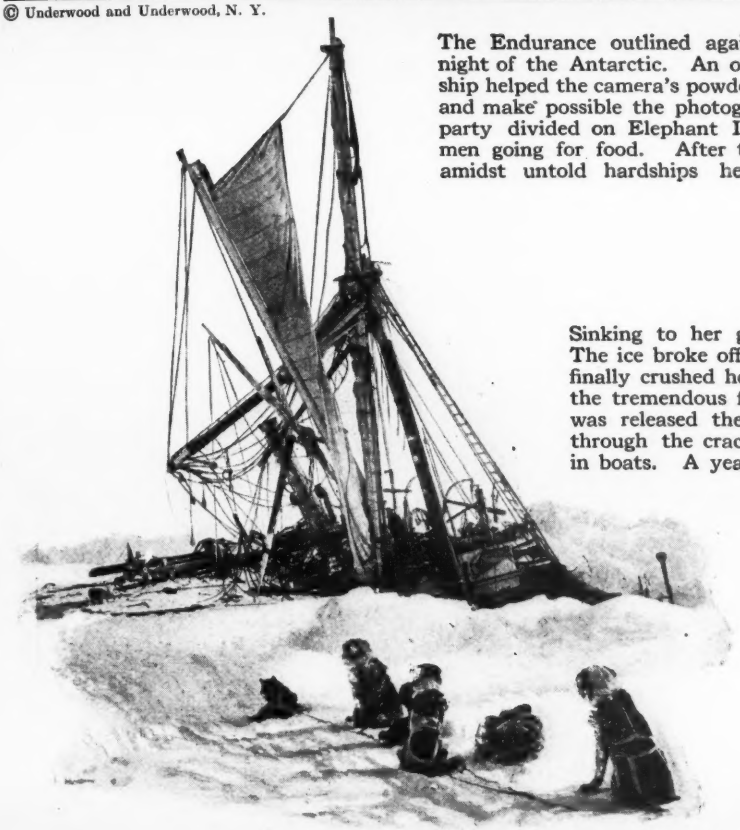
Sir Ernest Shackleton (right) and Captain Worsley watching the ice crush the Endurance. The gallant ship withstood the pressure for eight months. She broke free once but was hurled back

The ice field in which the Endurance drifted for months in the Weddell Sea. The boats, sledges and provisions were saved and the party trudged north until they could use the boats

the Weddell Sea After the Ice Had Crushed Her

© Underwood and Underwood, N. Y.

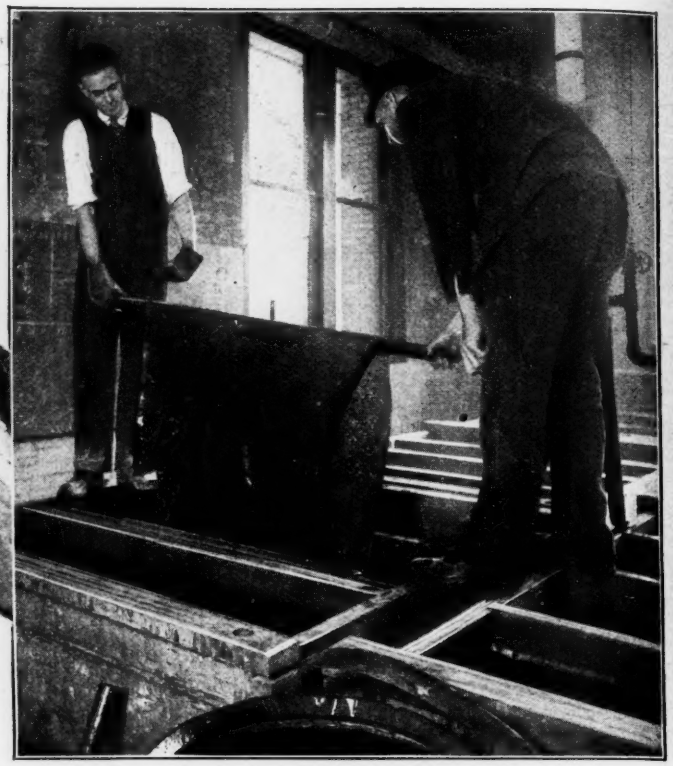
The Endurance outlined against the three-months-long night of the Antarctic. An oil fire near the bow of the ship helped the camera's powder flash to light up the place and make possible the photograph. After she sank, the party divided on Elephant Island, Shackleton and five men going for food. After three unsuccessful attempts amidst untold hardships he finally rescued his men



Sinking to her grave in the Weddell Sea. The ice broke off her masts and rigging and finally crushed her. When the pressure from the tremendous floes which hemmed her in was released the Endurance slipped down through the crack. The party then set off in boats. A year later they reached safety

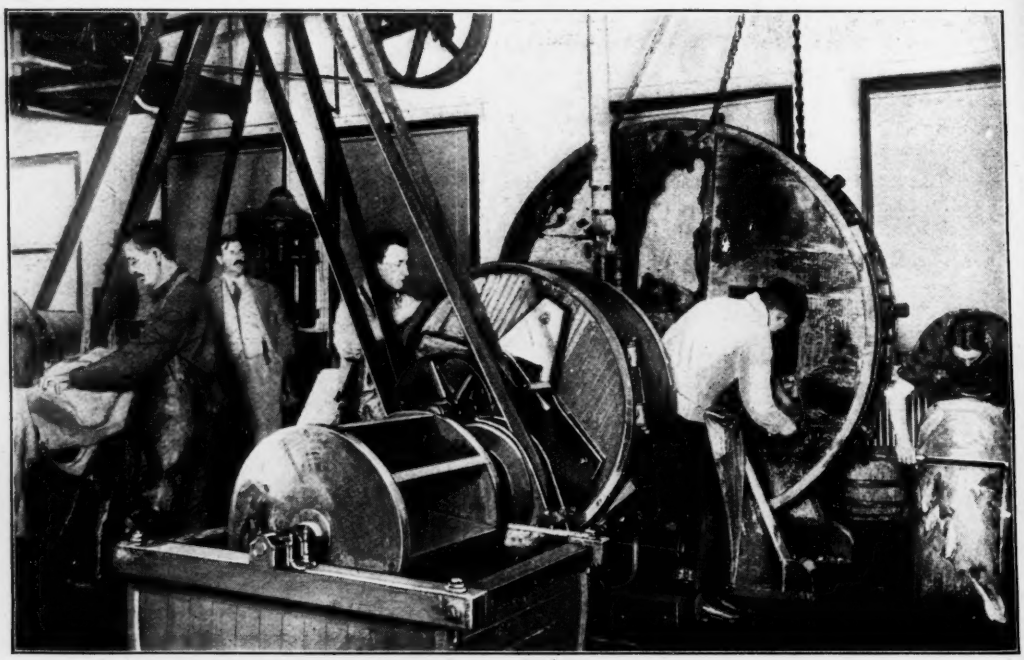
Teaching Students the Rudiments of Leather Making

A student at Pratt Institute learning to tan hides. He is removing the hair from a skin before placing it in the tanning vats. This is a tedious task

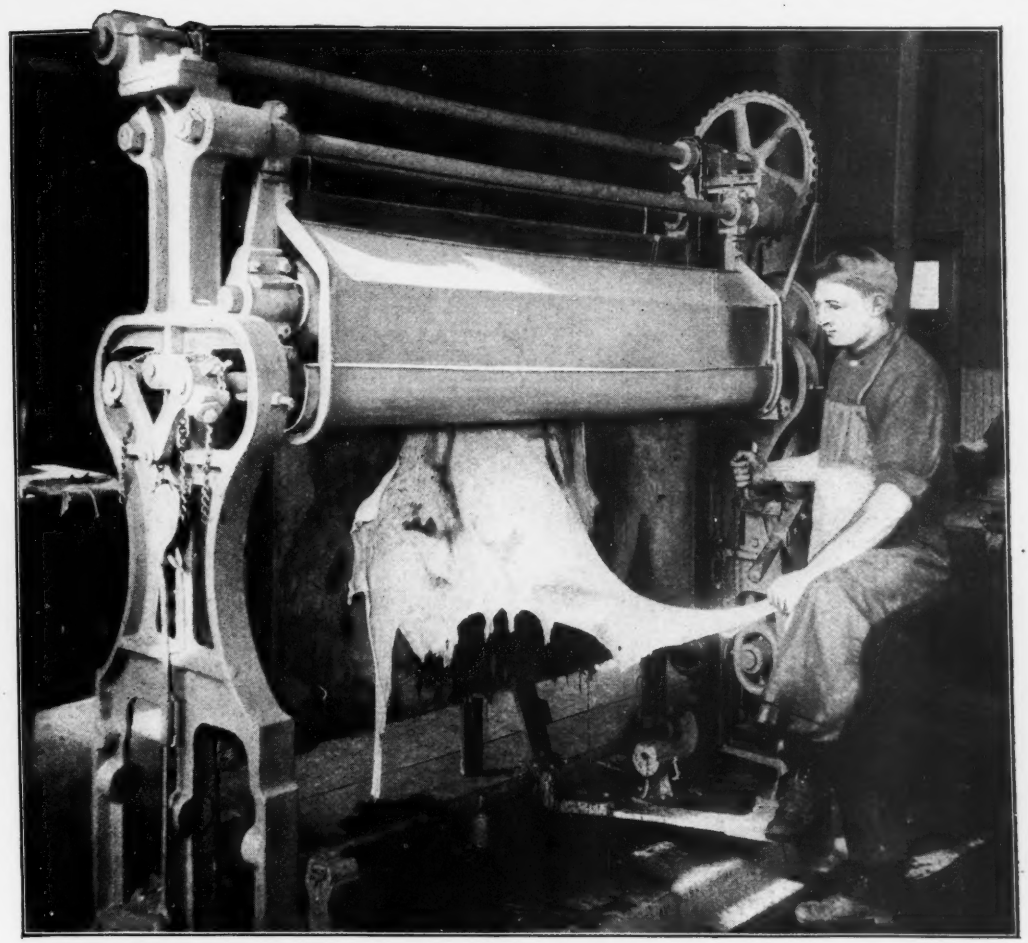


Handling the hides in the bark tan vats. The hides are allowed to soak in the strong solution for a specified time, after which they are removed in the manner shown

Photos © Press Illustrating Serv.

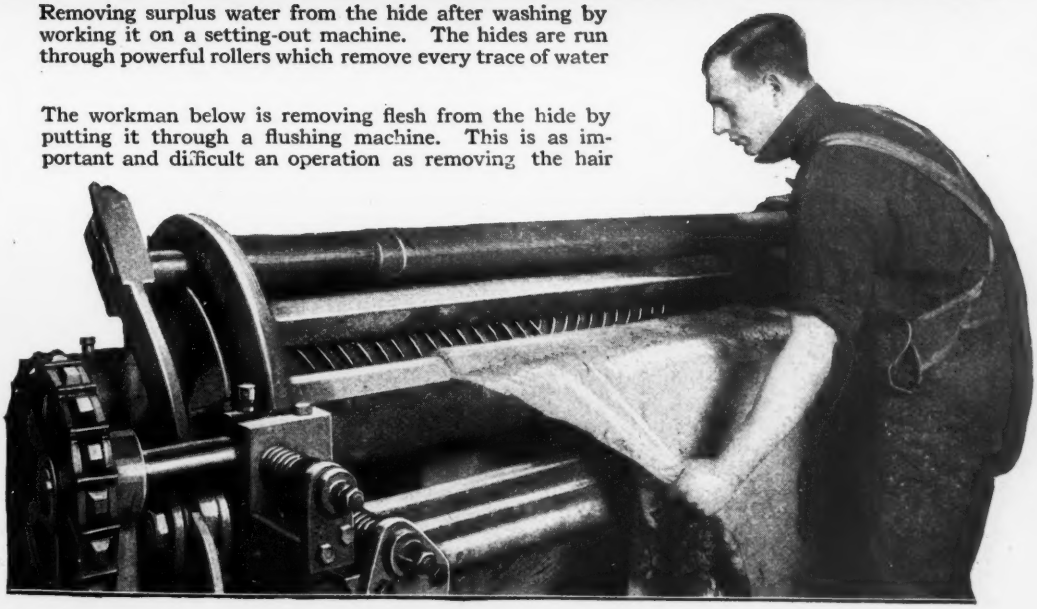


A class of students removing the stock from the coloring drum. All hair is removed before the stock is put in the drum. The machinery used in the process is the most modern



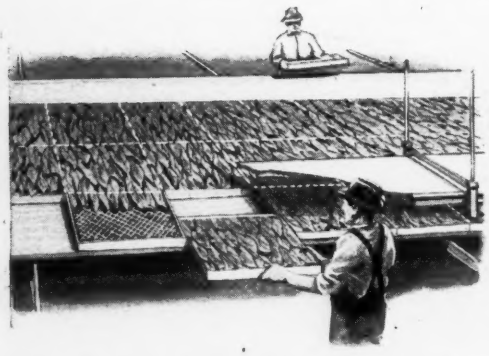
Removing surplus water from the hide after washing by working it on a setting-out machine. The hides are run through powerful rollers which remove every trace of water

The workman below is removing flesh from the hide by putting it through a flushing machine. This is as important and difficult an operation as removing the hair

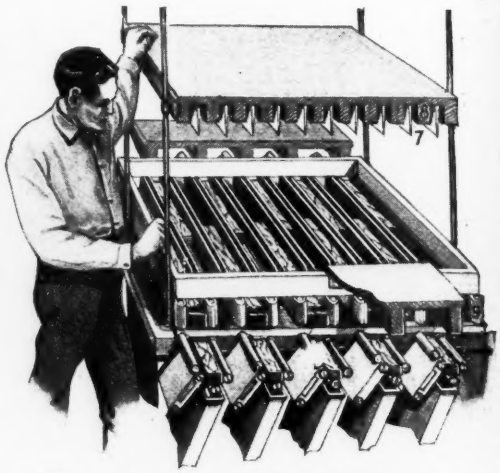


Making Cigars by Machinery

Mechanism detracts somewhat from the picturesqueness of the manufacture but not from the flavor of the product



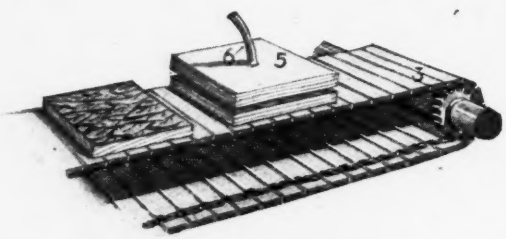
The tobacco leaves are laid evenly in trays having screen bottoms, and are conducted on an endless chain to the cutting machine



The assembled machine, showing the knives placed in series, with narrow compartments between for the leaf trays

THE old method of making cigars by hand, which involved much that recent investigations have revealed as unsanitary, is being supplanted by machinery. Albert A. Heyman, the inventor of the device which cuts and rolls the tobacco to form cigars in quantity, guarantees that the pipe-dreams ordinarily accompanying a "good smoke" will not lose in quality, even though the increased production and diminished labor attending it may reduce the price of the product. He also asserts that it will be possible to open a box of the machine-made cigars with perfect confidence that every one of them will be identical in blend, quality and strength.

In the manufacture of the cigars by machinery, the first step is the drying of the tobacco in trays. Then a frame fitted with knives is used to cut the edges, the trays being conducted to the cutting machine on a chain-conveyor, 3; each tray has a box cover, 5, provided with a rubber tube 6. (See illustration below). As the tray reaches the machine the suction applied above holds the layer of leaves up against a wire screening on the under side of the cover. The leaves are then released directly above the series of narrow compartments shown in the illustration of the assembled machine. If a blend is desired, each tray may contain a different kind of tobacco, a thick layer of the leaves being deposited on the machine preparatory to the cutting.



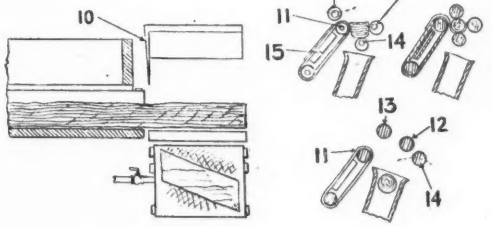
The trays, with cover (5) and suction tube (6) on the endless chain conveyor (3). The suction holds the leaves against the cover

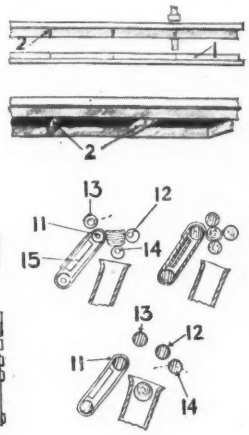
The knives on the cutting frame are attached in series, being separated by blocks which press the leaves down into the narrow channels. At the ends of these channels are rollers attached to an endless belt. After the tobacco has been cut and pressed down tightly into these channels, the belts are set in motion, each moving in an opposite direction to the one adjoining, so that the leaves will be forced outward. As the tobacco leaves this part of the machine, a knife located at right angles to the other knives (see 10, of detail drawing on next page) cuts it into the required lengths.

Thus a rectangular bunch of leaves is projected into a space, on either side of which is a roller (11 and 12, of detail drawing). Similar rollers, 13, 14, are adjusted above and below in such a way that they can be moved horizontally into position. The

action of these rollers is similar to that of a hand shaping the cigar.

After the familiar spindle-shape is obtained, a binder is placed on the porous belt which passes over the suction box 15. One end of the binder being glued and moistened, it is at once fastened around the cigar. Then the lower roller moves to one side and the finished cigar drops into a pipe below, through which it is conveyed to the cigar box.





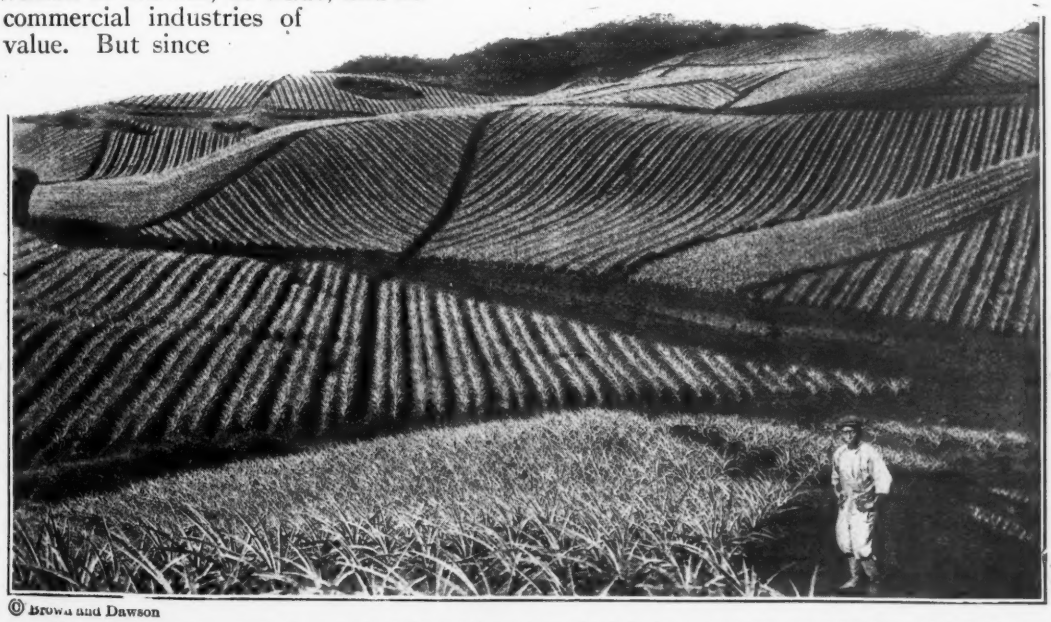
Detail drawing of the rollers and cutting frame of the cigar-making machine

By this method a great quantity of cigars, uniform in blend and quality, may be cut, shaped and packed in boxes in a mere fraction of the time formerly required and at little expense after the cost of installation of the machinery is met.

How a Boy Started the Hawaiian Pineapple Industry

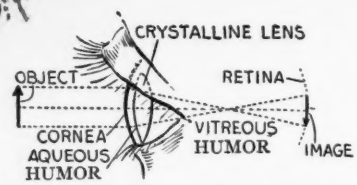
BEFORE the United States acquired them the Hawaiian Islands were famous chiefly for their natives and their leper colony. There were no special cultivation of the soil, no trade, and no commercial industries of value. But since the annexation to the United States in 1900, American enthusiasm and American progressiveness have invaded the land. The pineapple industry is one of the best illustrations of the result of this Americanizing. It was started almost by chance, by a comparatively uneducated, inexperienced New England lad, the son of a clergyman. He chose to locate in Hawaii on account of its wonderful climate, and finding that the pineapples were especially luscious and that they grew quickly and abundantly, he persuaded his father to secure a few thousand dollars for him to start him in the pineapple-raising business. It was a veritable get-rich-quick scheme. It has netted fortunes to each one of those friendly parishioners who advanced money for the venture.

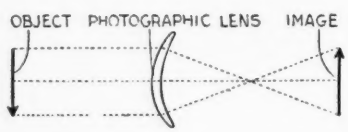
At first the fruit was sent to the United States fresh and was marketed along the Pacific coast. But now there is a cannery with a capacity of ten thousand cans an hour, from which the fruit is shipped to all parts of the world.



© Brown and Dawson

Two thousand acres of pineapples, laid out in geometrical designs over the undulating valleys of Hawaii. The land is of wonderful fertility in spite of the fact that it is of volcanic origin





The "mermaid" goggles in use in the picture above. At right: A diagram of the eye showing the convergence of light rays. The parts of the under-sea goggles

Eye-Glasses for Divers and Mermaids

WHY cannot the human eye focus sharply under water even when protected from it? Briefly, because the water makes the eye long-sighted. The human eye operates like a camera lens receiving the light rays from the image and making them come together or converge in such a way that half-an-inch or less will be sufficient to reproduce a twenty-foot object.

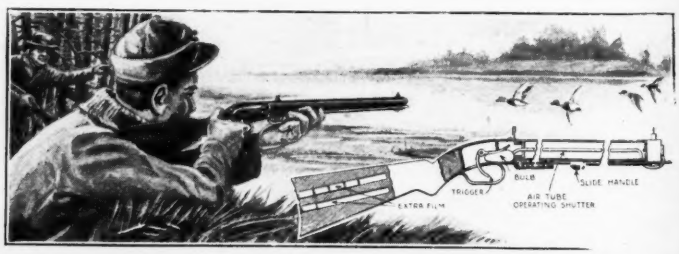
This convergence of light rays or waves, is due to the phenomenon of refraction. It happens that the "refractive index" of the front of the eye is practically the same as that of salt water. This means that the curvature of the front of the eye is lost under water, and the rays of light instead of being deflected by that curvature, as in the air, enter straight. Thus deprived of one of the lenses, the eye is of long focus and the objects instead of being reproduced in sharp focus on the retina, or back of the eye, go well beyond it and produce only an indistinct impression.

A pair of under-sea eyeglasses invented by Dr. Dudgeon, an English physicist, were designed to overcome this difficulty by means of an "air-lens." This air-lens consists of two surfaces of ordinary glass enclosing air and forming certain curves. In air it has no effect at all, neither magnifying nor reducing an object; but in the water it acts as a converger, and shortens the focus of the lens of the eye.

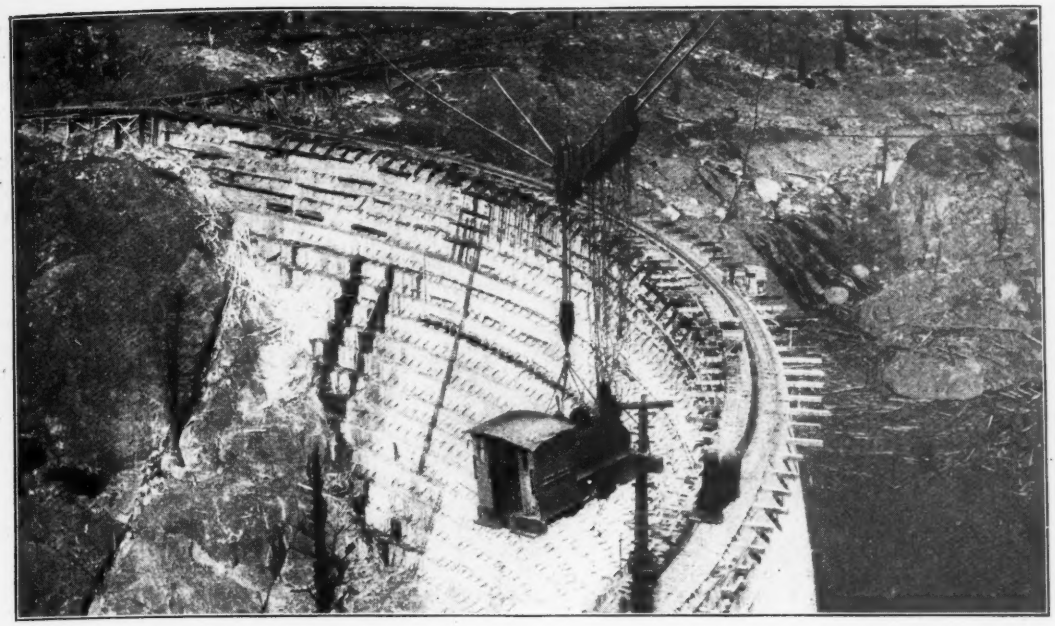
Taking Photographs with a "Shot-Gun" Camera

THIS gun-camera resembles outwardly the familiar "pumpgun" or repeating shotgun, with the stock, grip, trigger and slide-handle for the left hand. A small camera of the roll film sort is mounted in the large muzzle. Pressure on the trigger squeezes a bulb lying below it, which through tubing running to the shutter of the camera in the muzzle, trips it and makes the exposure.

The action slide handle under the left hand is arranged to turn a new strip of film into position for each exposure, and so permits the operator of the gun-camera to take pictures as rapidly as he would fire a regular gun of the powder and "bang," sort. Regular sights, front and rear, are mounted on the gun to direct it accurately.



He merely presses the trigger for the exposure, and rapidly operates the slide handle to turn off a new length of film, without the necessity of removing either hand from the gun



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The Spaulding Dam in California. The water that it will store will generate one hundred and seventy-five thousand electrical horsepower and will irrigate twenty thousand acres of farm lands

The Spaulding Dam—The Largest Power Dam in the Country

WHAT is to be the largest power dam in the country is now under construction in Nevada County, California. Stretching across a narrow gorge called Emigrant Gap, this dam will block up sufficient water to create an artificial lake nearly thirty square miles in area. What was once a miniature, lazy stream will thus be converted into a mighty lake.

When completed, the dam will rise three hundred feet above the flooring of the rocky gorge. At the top, it will stretch across the gorge for even twice this distance. The water the dam will control will be fed to a half dozen hydro-electric power plants strung along the downstream side of the river.

The water stored by this dam will add one hundred and seventy-five thousand horsepower to the electrical power the United States is already obtaining from her natural water resources. This power will be carried over transmission lines a distance of over one hundred and fifty miles to San Francisco. Other cities near the coast will be supplied also. After the water of the lake has turned the turbines in all the power houses, it will then be used to irrigate the lands of the Sacramento Valley.

Making Buttons, Bric-a-brac and Silk from Milk

ALTHOUGH anyone will concede that man cannot live by bread alone, it has been thought possible to get along rather nicely if milk were added to the diet. But it remained for two French chemists, Francois Lebreil and Raoul Desgeorge, to conceive an idea whereby milk may also be made to yield a fabric which may be converted into clothing and ornaments. The curds of the milk are subjected to a chemical treatment by means of which the mass is converted into a plastic substance which may be rolled into sheets resembling celluloid, from which buttons and other articles such as combs, umbrella handles, bric-a-brac and even imitation leather may be made, all of which are of attractive appearance and of excellent wearing qualities.

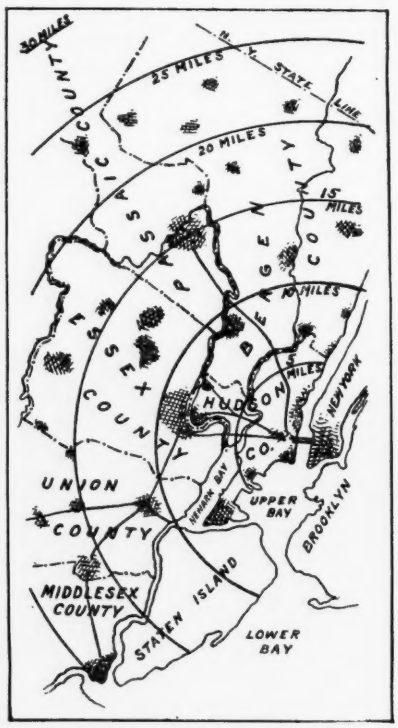
The milk is first robbed of its fat, after which it is warmed with rennet so as to form curds. It is then parboiled and exposed to the air, and then it is treated with acetone to give it the required hardness, plasticity and transparency. The product may be made so soft that it can be used as a substitute for silk in the manufacture of fine underwear, or it may be made solid enough to serve as a good imitation of ivory.

Under the River with Horse and Cart

An ambitious plan to solve New York's ferry congestion by subterranean roadways

As a means of relieving the ferry boats that ply between Manhattan Island and the mainland two highway tunnels under the Hudson River, which will serve New York and New Jersey in practically the same way that the Blackwall and Rotherhithe tunnels under the Thames serve the city of London, have been proposed by the engineering firm which built the two Pennsylvania railroad tubes and the four Hudson and Manhattan railroad tubes. The plans are now being considered by the New York State Bridge and Tunnel Commission.

Despite the increasing number of larger and speedier ferry boats the problem of carrying wagons across New York's waters is no nearer solution than it was years ago. The advent of the automobile has only served to make matters worse, until, at the present time, over-river traffic is in a state of chronic congestion. The delays in making deliveries are not only more frequent, but in some cases, particularly at certain times of the year, deliveries can not be made within any stated period at all. The under-river roadways, it is claimed, will eliminate all this.



The districts which the proposed tunnels will serve. The total length will be eight thousand three hundred and fifty feet

A total of nineteen thousand six hundred and sixty vehicles crossed the Hudson River on ferries during the year 1913. Not more than two thousand of these vehicles used the ferries north of Twenty-third street. Most of the traffic is downtown. For this reason the proposed tunnels are to serve the congested district by starting from the New York side at Canal Street, practically given over to vehicular traffic as it is, and will enter New Jersey at Twelfth Street, Jersey City.

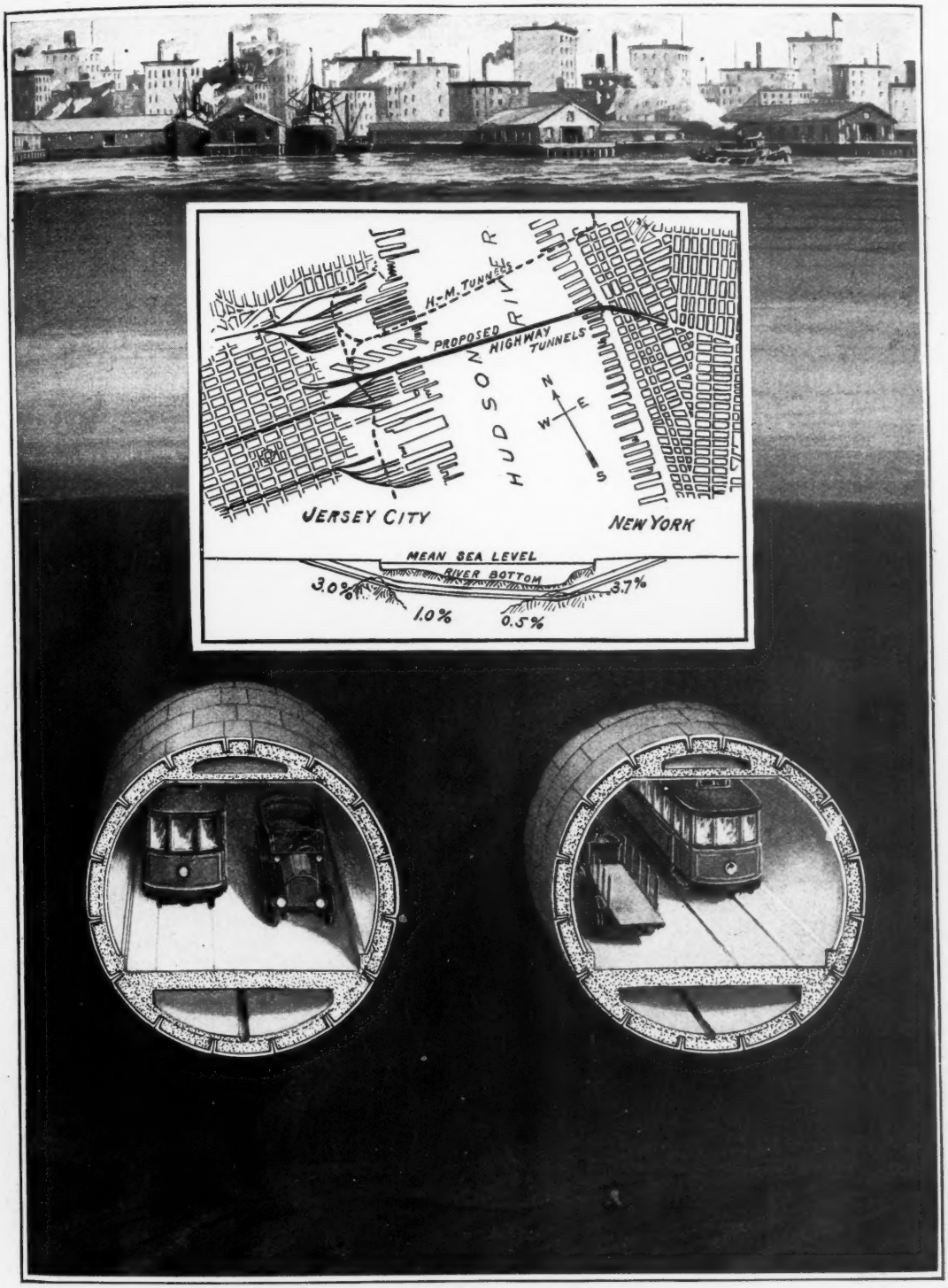
The total length of the tunnels will be eight thousand three hundred and fifty feet, and at their lowest point they will be eighty-nine feet below the surface of the Hudson River. The rise to the surface on the Manhattan side will be on a grade of 3.7 per cent and the grade on the New Jersey side will be 3.0 per cent. The grades below the river will be 0.5 and 1 per cent.

One tunnel will be for eastbound traffic and the other for westbound. The roadways will be approximately seventeen feet in width. The engineers figure that the two tunnels will have a capacity of five million vehicles a year. The Blackwall and Rotherhithe tunnels, each consisting of a single tube and providing for traffic in both directions in one tunnel, accommodated almost one million vehicles in 1913, including automobiles. There are tunnels in Glasgow and Hamburg with separate tubes for the traffic in each direction.

As will be seen in the illustration on the next page a ventilating duct of large capacity is provided beneath the roadway, with frequent openings leading to it. The engineers claim that the gases of combustion carried into the tunnel by the great variety of products transported from one side to the other, will settle to the floor and be drawn into the main ventilating conduit and so out of the tunnel. Whether this method of purifying the air will be finally carried out or not remains to be seen.

Powerful fans have also been suggested as the simplest means to keep the air pure. Another feature may include the provision of elevator shafts connecting the tunnels with the waterfront in addition to the inclined approaches.

Bringing New Jersey to New York

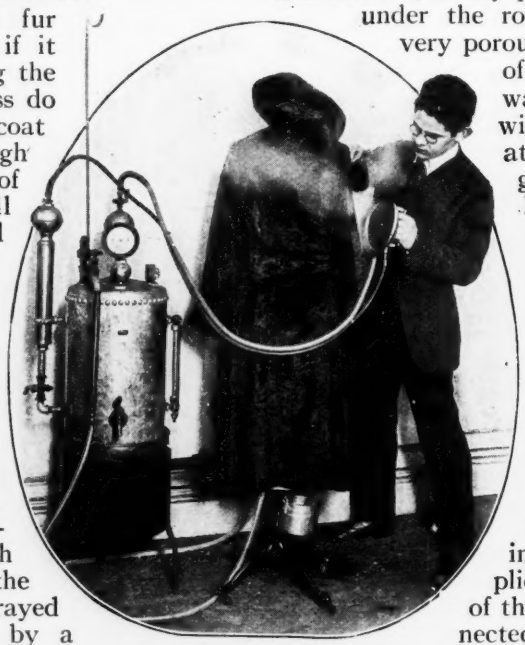


The old nursery riddle "What is it that is under the water, over the water and yet is not touched by the water?" might well be answered in this age by reference to the vehicular traffic between New Jersey and New York. In the center of the photograph is shown a diagram of the proposed under-river highway which the New York State Bridge and Tunnel Commission is considering to relieve the ferry-boat congestion over the Hudson. Notice the ventilating ducts of the tubes

If Your Fur Coat Is Dingy Steam Will Restore Its Gloss

WHEN the old fur coat looks as if it were fast approaching the limits of its usefulness do not despair. A fur-coat doctor can put it through a five-minutes course of treatment which will make it fresh and youthful.

He gets his results simply by steaming the coat—steaming it inside and outside at the same time and rubbing it briskly while the fur is damp and hot. The coat is placed over a rack. Steam enters the inside of the coat through a tube attached to the rack. Steam is also sprayed against the outside by a special apparatus held in the hand of the cleaner. As soon as the steam comes through the coat from the inside, the cleaner brushes the fur until it shines. Five minutes after the steam has been cut off the coat is ready to be worn.



Steam cleaning by brushing and spraying the coat inside and out at the same time

The steam is generated by a gasoline-burning boiler. The sprayer held in the hand is simply a perforated metal disk.

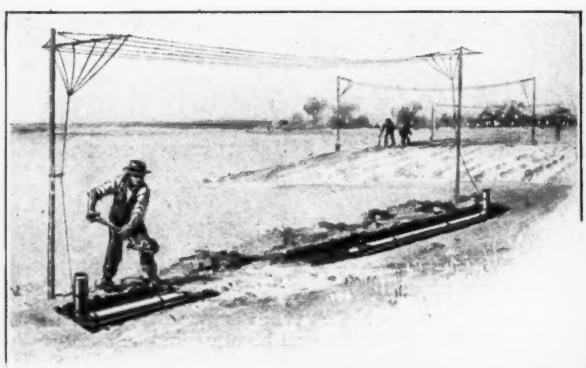
Stimulating a Plant's "Digestion" by Electricity

THERE are several electrical methods in use to-day for stimulating the growth of vegetation. It seems that a plant cannot absorb any food from the soil until some of the fertilizer present has been reduced to its simpler chemical compounds. But an electric current coursing through the soil can hasten the breaking up of the fertilizer into its component elements. Such a current will therefore release greater food supplies in the soil, and the plant will grow faster and to a far greater size as a result of the great supply of nourishment thus produced.

Perhaps the simplest of all methods for stimulating plant growth in this way is that recently devised by Warren J. Anson, of Los Angeles, California. In his method, shown in the illustrations, a clay pipe is buried directly under the row of plants. This very porous pipe has a number of electric wires in its walls. The ends of the wires are joined together at the surface of the ground, whence they lead to a source of alternating current. It is this current which when carried in the wires courses through the soil surrounding the pipe. The current in this way reaches the fertilizer at the plant roots and stimulates the growth.

There are two ways in which the alternating current can be supplied. First, the wires of the pipes can all be connected together and run to a small dynamo. This method is particularly desirable for stimulating the growth of delicate plants, since the comparatively large current serves also to warm the soil.

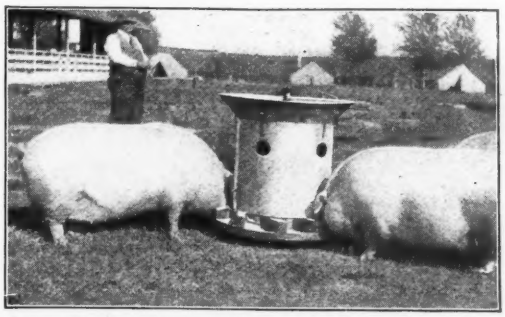
The vegetation raised on an ordinary farm, however, is hardy and this heating is unnecessary. In this case, the current is needed only to act upon the fertilizer. The electricity present in the atmosphere is sufficient. For collecting this electricity, the farmer can erect several wires high in the air. One method of construction is shown in the illustration, although the inventor does not mention how high it is necessary to carry the wires over the ground.



An alternating current carried through the clay pipe stimulates the food absorption of the plants

Making Hogs Grind Their Own Grain Food

A MACHINE which keeps hogs from squealing, teaches them better table or rather trough manners, and actually turns their rooting propensities to account in grinding their own feed, is a product of the inventive genius of a Minnesota farmer. While the inventor does not claim that his device will muffle the sounds from a pen absolutely he has proved that the "hog motor" is of value in economically feeding hogs and preventing the waste of grain inevitable with the hand or trough method of feeding ordinarily employed.



One pig pushing against the blades is sufficient to start the machine grinding the grain

The hog motor is similar in appearance to a small water-driven turbine. It consists of a reservoir of galvanized iron fitted with a conical weatherproof top into which the grain is poured. The grain drops out at the bottom and is automatically fed into a set of grinding burrs attached to a movable set of wooden blades, the whole being mounted on delicately adjusted ball bearings. The snout of one pig pushing against the blades is sufficient to set the machine in motion, and as the grain is ground it drops in front of the pig's snout. In endeavoring to eat up the feed the hog gradually pushes the blades around and more grain is dispensed. In this way the machine operates continuously, the speed being governed by the agility, appetite and snout activity of the pigs.

From the description it might be inferred that the hogs require educating to feed themselves with the device, but it is only necessary to sprinkle a few grains of feed in front of the blades and the animals will soon learn how to work it. One of the main features in favor of the device is that it allows the economical feeding of damaged grain which it would not pay to have ground. The inventor claims that a fairer distribution of the feed is possible with the motor than without it; for each hog gets only what he works for, and no hog interferes with another.

The Strangling Fig—A Terror of the Vegetable Kingdom

PLANTS can be as cruel as animals, judged by merely human standards. Just as there are dastardly and cowardly birds and fishes so are there murderous plants. That, briefly, is the way in which the strangling fig is regarded. The illustration shows this relentless pest strangling a palm tree, around which it is drawing its sinews tighter and tighter. It is not a parasite; it obtains its sustenance through its own roots.

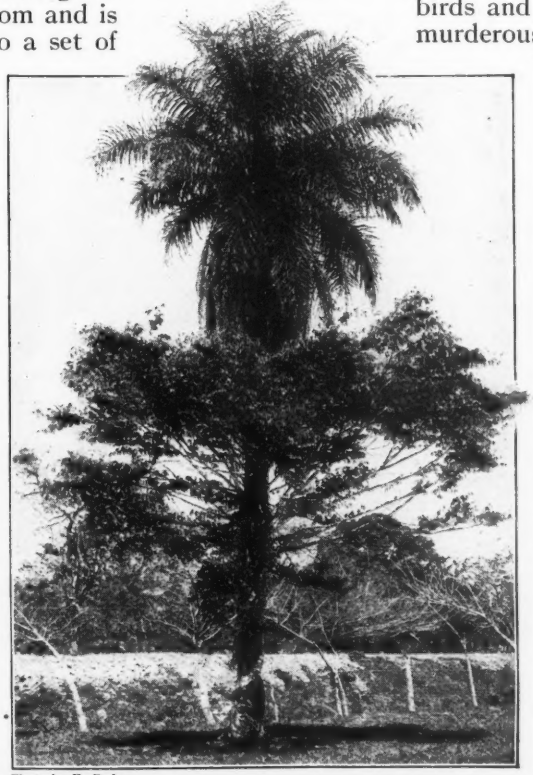


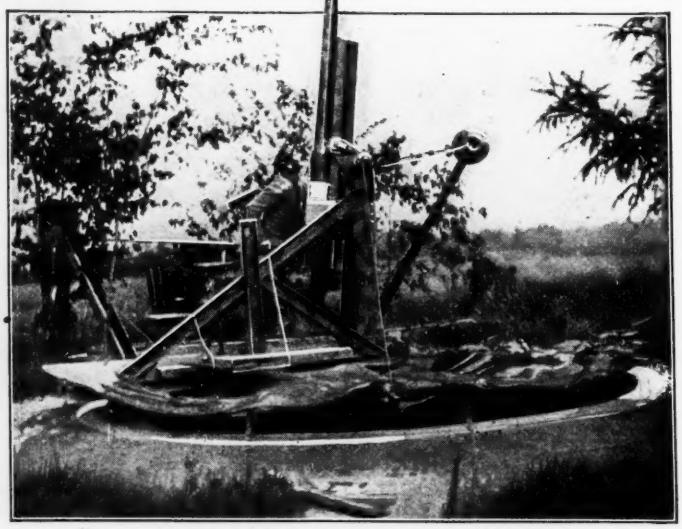
Photo by E. Bade

The fight to the death between the strangling fig and the practically defenceless palm tree

This enables it to grow rapidly, destroying its victim inch by inch, until there is no visible sign of the original tree at all. The strangling fig belongs to the same genus as the common fig tree. It grows in the most tropical part of Florida and in portions of the torrid zone.

Shooting at Bird-Men with the New French Guns

IF you have ever shot ducks on the wing with a shot-gun, you have experienced some of the difficulties of the artillerymen who handle anti-aircraft guns on European battlefields. Your practiced bird-shot aims a little ahead of his prey. Beyond this time allowance, he considers nothing. He fires point-blank at his mark.



A new gun, so mounted that it can be fired at the steepest angle. A perforated weight counterbalances it

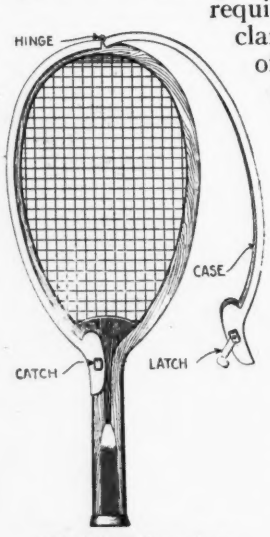
And so it is with the man who fires shrapnel at artificial birds soaring at a height of a mile and more. His task is far more difficult than that of the duck hunter. The allowance which must be made for the movement of the air-man and the time required by the projectile to fulfill its mission is not so easily gaged as it is with a fowling piece on the ducking ground.

Before the present war, not a single anti-aircraft gun could be fired point-blank at an aeroplane in the air. The necessity of that proceeding seemed so obvious that I pointed it out more than once before 1914. That it has indeed become essential the accompanying illustration abundantly proves. Compared with this well-constructed and easily handled weapon the anti-aircraft guns with which European armies were experimenting before the war, seem ridiculously awkward. They could not be fired point-blank, for example; they had to be sighted around a corner, as it were, inasmuch as the marksman had to keep his eye glued on a reflecting prism. It was necessary to find the range and therefore to lose valuable seconds—something which is altogether unnecessary in point-blank firing.

The gun pictured, a French design, is so mounted that it can be fired at the steepest angles. It is so counterbalanced (note the perforated weight at the right) that it can be swung about with the utmost ease. The position of the marksman shows that he sights as directly as if he were manipulating a telescope instead of a gun.—CARL DIENSTBACH.

A New Press for Preventing the Tennis Racket from Warping

TO prevent the wood of tennis rackets from warping, a press is used consisting of perfectly straight brackets clamped on the racket when it is not in use. The brackets generally used to-day, however, require considerable adjustment to clamp them properly. They consist of a pair of trapezoidal pieces of well-seasoned wood which are held flat against the racket on either face by four wing-nuts which clamp them down and which must be screwed to exactly the same tension.

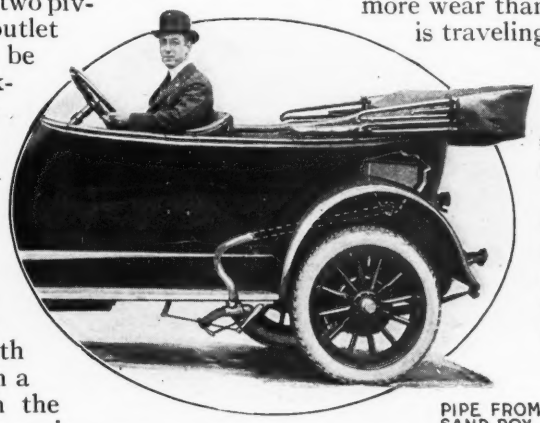


The hinged brackets fit the sides of the racket, holding it rigidly straight

A far simpler bracket has been invented by Fred Ricords, of Brooklyn, New York. Instead of face brackets, two side brackets semi-elliptical in shape are used. They take the contour of the sides of the racket when closed together. The brackets are made perfectly straight longitudinally, and when they are fitted on the sides, they hold the wood so that it cannot warp.

If the Road is Slippery, Sand It with the Newest Automobile Accessory

SOMEWHAT like that of a human arm in operation is the action of the adjustable sanding device for automobiles shown in the accompanying illustration. Its principal features are two pivoted fan-mouthed outlet pipes, which may be swung forward or backward at the will of the driver to deliver a large quantity of sand at the peripheries of the driving wheels, or lesser amounts on the roadway in front. The sand is fed from a V-bottomed box, beneath the rear seat through a pipe connected with the outlet-pipes. These are pivoted on a crosswise shaft which extends beneath the vehicle and which is revolved by means of rods and a lever beside the driver's cab. Rubber-faced disks pivoted on the ends of the pipes keep the sand in when the device is not in use. These disks are carried on toggle arms fulcrumed on the crosswise shaft.



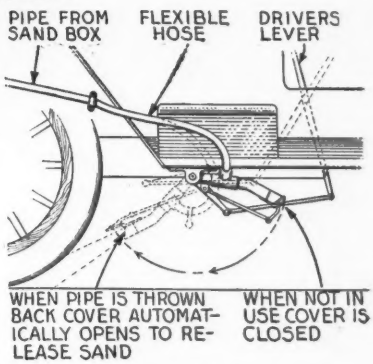
The road is slippery? Pull a lever and you sand it, just as if you were on a locomotive

The sand is fed from a V-bottomed box beneath the rear seat, through a pipe

When the driver moves his lever forward, the outlet pipes swing down and backward, the opening of the disks on the pipes increasing as the lever is moved forward. When the ends of the outlet pipes are nearest the peripheries of the wheels, the disks are fully open. The greatest amount of sand is discharged when they are in this position. In intermediate positions they are not open so wide, so that a smaller amount is deposited on the roadway.

This method for preventing skidding is less severe on the tires than any of the others now in use. Chains placed on the rear tires, for example, tend to wear themselves into the tires. The indentations they make weaken the tires prematurely. When sand is discharged under the tires, there is no more wear than when an automobile is traveling over a country road. No indentations are made, and the life of the tires are not shortened as a consequence.

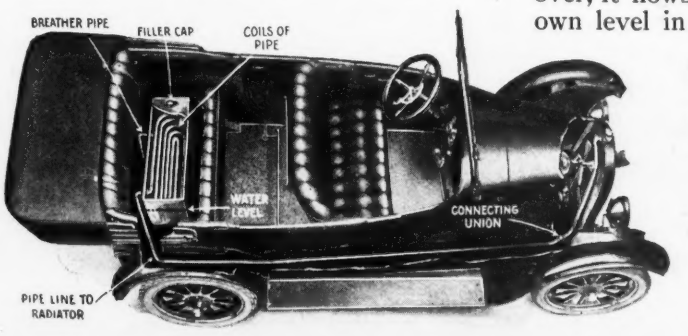
The sand makes it possible to travel over icy pavements as well as over roads that are simply slippery from the rain.


PIPE FROM SAND BOX
FLEXIBLE HOSE
DRIVERS LEVER
WHEN PIPE IS THROWN BACK COVER AUTOMATICALLY OPENS TO RELEASE SAND
WHEN NOT IN USE COVER IS CLOSED

Novel Tank Condenses Boiled-Over Radiator Water

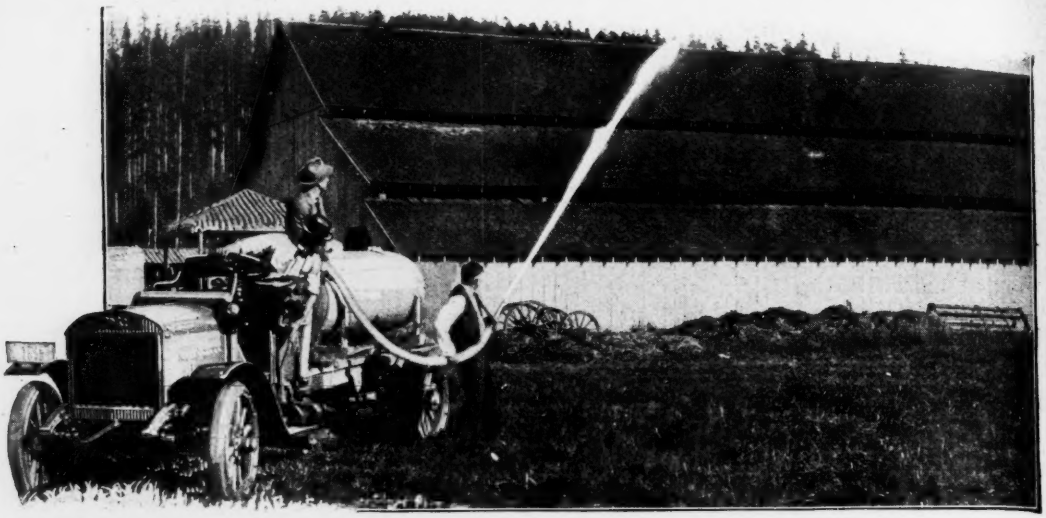
A SMALL tank under the rear seat is provided with a coil of copper piping led forward to the top of the radiator. The end of the pipe coil is kept under the surface of the water in the tank, forming a water seal. When the water in the radiator boils over, it flows down the pipe and seeks its own level in the tank where it is cooled. Due to the water seal, the admission of water in the tank causes a vacuum in the radiator and this sucks cooler water back into it, always keeping it full.

The tank has a filler cap which is reached by removing the rear seat cushion. It also has a breather pipe to discharge the excess water automatically should the tank overflow.

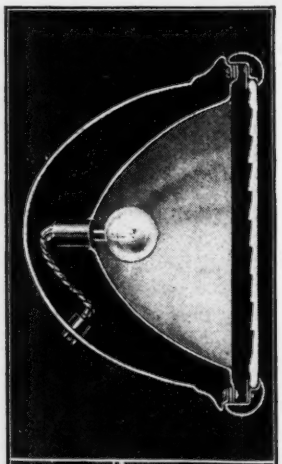


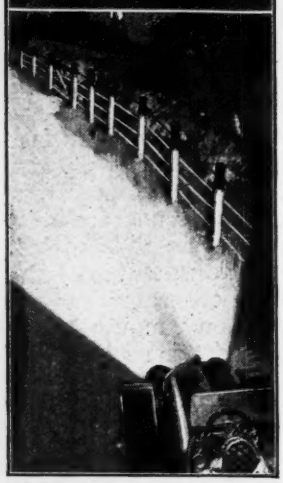
The tank and coil of copper piping under the rear seat are connected with top of the radiator to receive the overflow

A Fire-Fighting Truck and Numerous Comforts



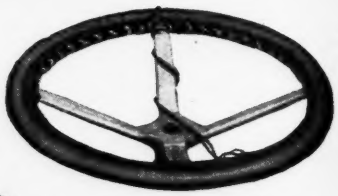
For spraying or fire-fighting—a motor-truck equipped with a power pump which is operated by the automobile engine and a tank with a capacity of twenty-five barrels. The water-tank is detachable





A no-glare headlight which keeps the light within forty-two inches above the road. Its range is five hundred feet

A face shield of celluloid or other transparent material which is securely clamped to the hat rim protects the face from dust and driving wind

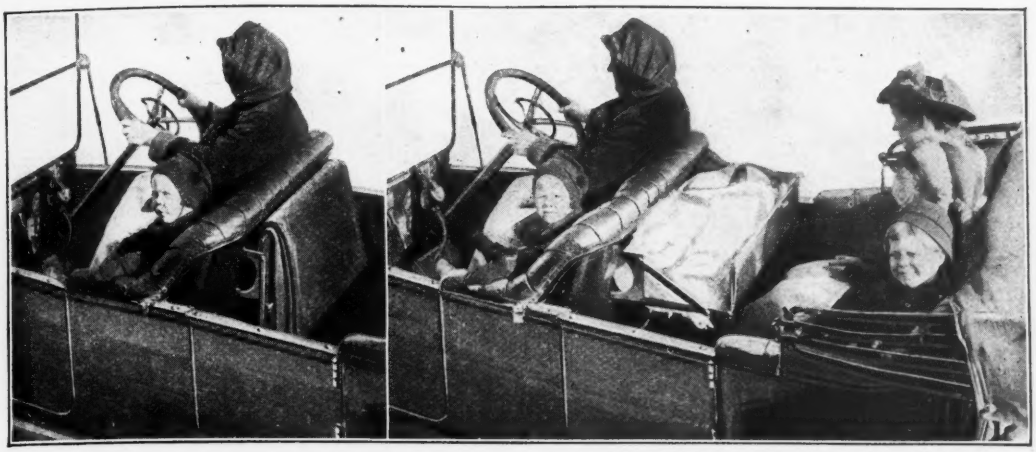


Cold hands are the special trial of the motorist during winter; hence this electrically warmed steering wheel. Two resistance wires under canvas do the heating

A lap robe for the chauffeur which covers the entire front seating space, retaining all the heat from the engine

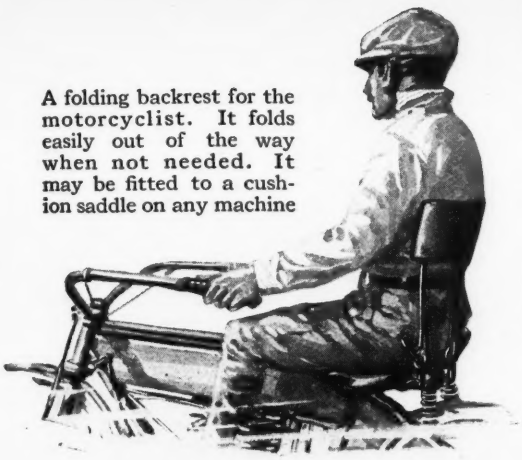
The dancing doll on the radiator carries a fan in each hand. In a brisk breeze she becomes very animated

and Conveniences for Cold Weather Motoring



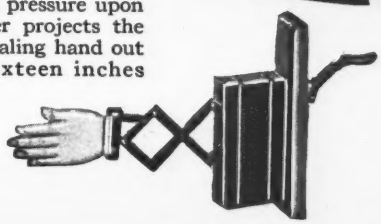
A combined baby-carrier and robe-rail for the touring car. The parts are collapsed as at left end of the photograph to serve as a robe-rail, and distended or assembled to support the baby

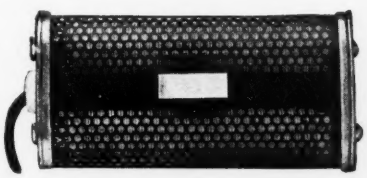
A folding backrest for the motorcyclist. It folds easily out of the way when not needed. It may be fitted to a cushion saddle on any machine



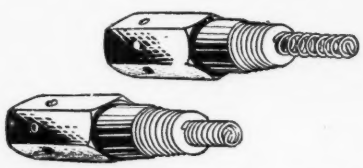
A foot muff with an opening large enough to hold both feet and to keep them warm, too

A slight pressure upon the lever projects the red signaling hand out fully sixteen inches

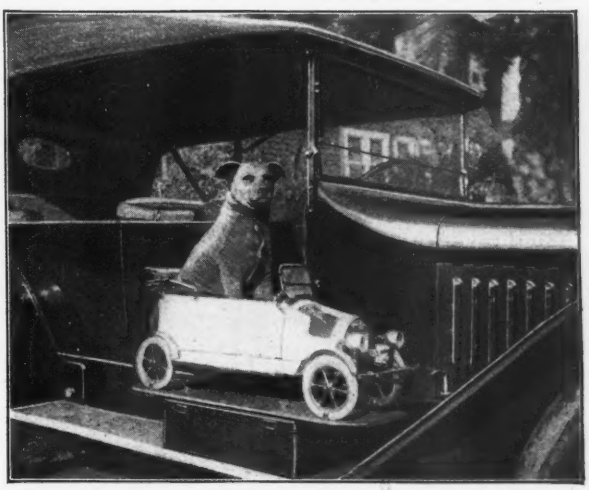




An electric heater which keeps the carbureter warm and eliminates the danger of the radiator's freezing



A hollow nut with a coiled spring for motorcycle cylinders. It shuts off air from or admits it to the cylinders as the suction increases or decreases



An individual automobile for Muggins. It is carried at the side of the large car and has headlights, tail lights and a little searchlight of its own, all of which work, so that the miniature car may be run separately

A child can have no end of fun with these interlocking animals. The head of one can be exchanged for that of another and the most outlandish freaks can be formed

Freaks of Nature—And How to Make Them at Home

MANY persons have had the opportunity of seeing some of nature's freaks. But few have had the opportunity of making them! James J. Kennedy, of Brooklyn, New York, has, however, found a way by which they could do even that. With his wooden animals which have interlocking parts, one can take the parts of one animal and jumble them with those of another, and the freaks so formed may be even more outlandish than real ones.

Each of the animals of a set is cut from wood about an eighth of an inch thick. The animals are further cut up to form several joints which are used to connect their heads, legs, and other members with the animal's body. The sides of these interlocking joints fit closely together, so that the various parts can be held in place securely.

The joints are all of the same size. Hence it is a simple matter to unloosen some member of one animal and fit it into the body of another. A rooster's head could be placed where a giraffe's ought to be, or a giraffe's could take the place of a bird's! In fact the variety of figures that may be made is limited only by the number of pieces in the set and the child's imagination, as every piece may be made to fit into every other piece.

Footprints on the Sands of Time? No; Handprints in Concrete

POETS and philosophers have given plenty of practical suggestions as to how to leave enduring ethical marks; but it remained for a contractor and builder of Los Angeles, Cal., to find a way to make our individual impress in the cement sidewalks in front of our homes, so that even the passerby may feel the family spirit of the place.

While the builder was laying the sidewalk in front of his new home, his small son availed himself of the privilege of an only child to get persistently in the way. Several times the trowel smoothed over little footprints that marred the surface. At last the father thought of a way of taking the child into partnership on the job. He had the boy lay both hands deep down in the drying cement so as to make a well-defined impression, just in the center of the gate-opening. Underneath, the date was printed. Thus a mark was made which has defied time and weather and is full of suggestion to the immediate members of the family.

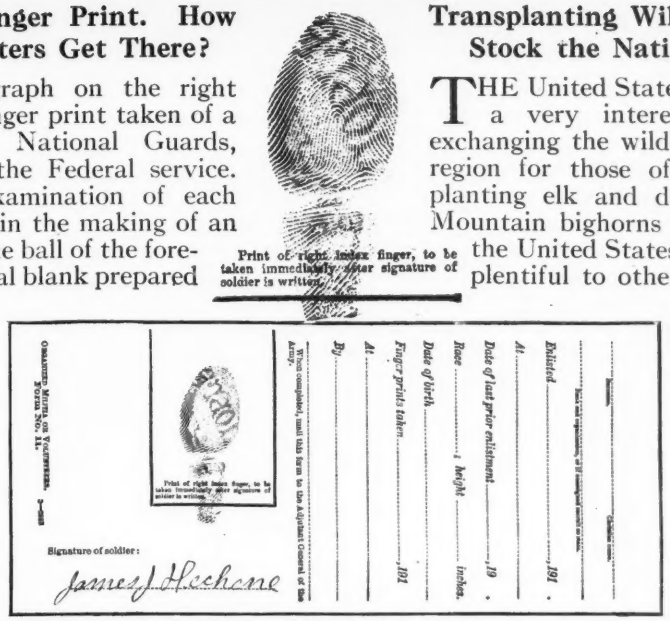
The idea which was so casually developed through the presence of a mischievous child, might be applied in other ways which would make it decorative and of value to anyone into whose hands the house might eventually fall. A fern leaf or other similar object might be embedded in the concrete so that a definite outline would be obtained. On municipal property or in front of public buildings the seal or other emblem of the city might be used.

The baby hands were pressed deep into the drying concrete and the date printed underneath to make a distinctive family mark

A Curious Finger Print. How Did the Letters Get There?

THE photograph on the right shows a finger print taken of a recruit to the National Guards, mustered into the Federal service. Part of the examination of each recruit consists in the making of an impression of the ball of the forefinger on a special blank prepared for the purpose. The recruit signs the blank and affixes his seal in the form of a finger print.

When the attention of James Dechene, the recruit in question, was called to the impression which he had made, he was as much surprised as the examiners at the raised letters shown. His occupation had been that of a tool dresser for oil well operators, before he enlisted. The tools which he handled were large, and the end which he would naturally hold was always cool or cold, so that there seemed no explanation as to how he received the lettering on his finger nor as to what the word was of which they formed a part. He could not remember having received any burn or handling any heated stamped metal.

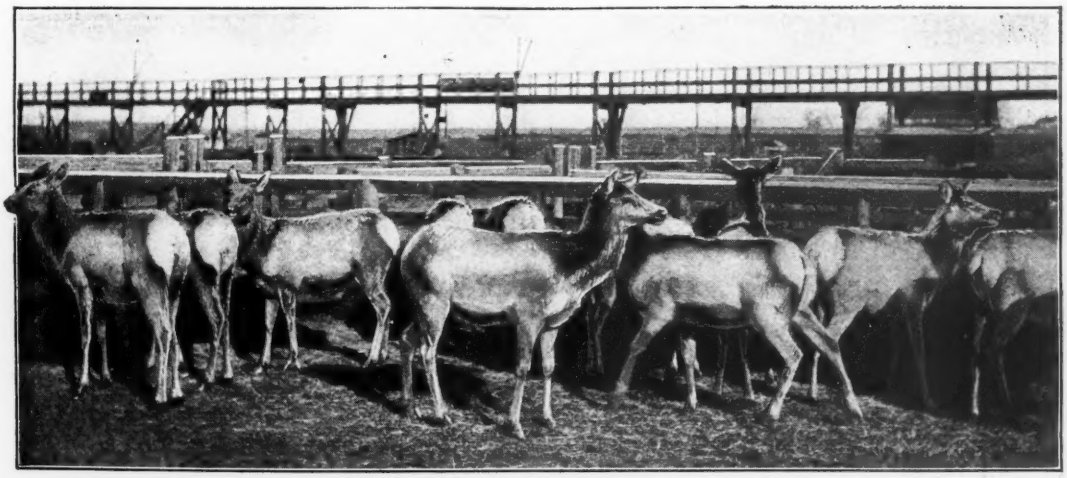

Print of right index finger, to be taken immediately after signature of soldier is written.
Signature of soldier:
James J. Dechene

The letters **UOPLE** stood out in bold relief on the recruit's finger print, though what they meant he did not know

Transplanting Wild Animals to Stock the National Parks

THE United States is carrying on a very interesting work in exchanging the wild animals of one region for those of others—transplanting elk and deer and Rocky Mountain bighorns from regions in the United States where they are plentiful to others where, so far as known, they have not lived. Some of the animals are being shipped long distances.

Wyoming is full of elk; the herds in the Jackson Hole country are the largest of any of North American wild animals since the days of the countless buffalos. But the big Yosemite National Park of California, with its three quarters of a million acres, until recently had no elk, or at least only a very few scattered specimens. But the elk shipped in from Wyoming have become very much at home and are breeding and multiplying rapidly, adding to the charm and picturesqueness of this popular national playground. The photograph shows a carload of yearling elk shipped by the Government from Jackson Hole down into Colorado.



A carload of yearling elk shipped by the Government from Jackson Hole, Wyoming, into Colorado. They are lying over for a few days at the Denver stockyards for the sake of exercise

Why Zeppelins Are Frightful

How a Zeppelin is built, how it navigates, and how it drops bombs

By Carl Dienstbach

THERE are three ways of building a dirigible airship. The first and the oldest consists simply in suspending from a cigar-shaped gas-bag a car in which the motor is carried. Such an airship (the non-rigid type), made famous in our time by Santos-Dumont, is apt to "buckle"—in other words, to break or bend in the middle. It can never be made very long for that reason. To prevent buckling the "semi-rigid" type of airship was invented—a type in which a stiff keel is attached to the under side of the long gas-bag, from which keel the car is suspended. The French built many semi-rigid ships of large size and proved conclusively that the idea is fundamentally sound. Then came old Count von Zeppelin, with his rigid type. Zeppelin had been an *attaché* in our Civil War and watched with great interest our attempts of over fifty years ago to use captive balloons for reconnoitering.

An Airship Must Preserve Its Shape at All Altitudes

Von Zeppelin had a good deal more in view than the building of a long airship which would not buckle or break in two. When a balloon or an airship of any kind rises, the gas within the envelope expands. At great heights it becomes necessary to let out some of the gas to prevent the bursting of the envelope. When the aeronaut drops later to a lower altitude the gas contracts, with the result that the envelope is only partly filled. That condition is dangerous because the strains are no longer distributed properly. What is more, the shape of the gas-bag is not the best for speedy propulsion. Therefore, all airships, with the exception of those of Count von Zeppelin, use what are known as "ballonets"—small air-bags within the big gas-bag. As soon as the airship drops, a blower connected with the air-bag by a pipe is started up in the car, and the air-bag is inflated to such a degree that the gas-bag in turn is distended to the full.

Count von Zeppelin wanted an airship that would preserve its shape at all altitudes, something that would not buckle. So he conceived an airship which consists of a very light but strong frame several hundred feet long. Within the frame he disposed a dozen and a half separate gas-bags. The outside of the frame was covered with a tightly stretched fabric. From the frame two cars were suspended in the earliest models. The cars were connected by a gangway and they contained the motors.

The Art of Building a Zeppelin Is Not Acquired Over Night

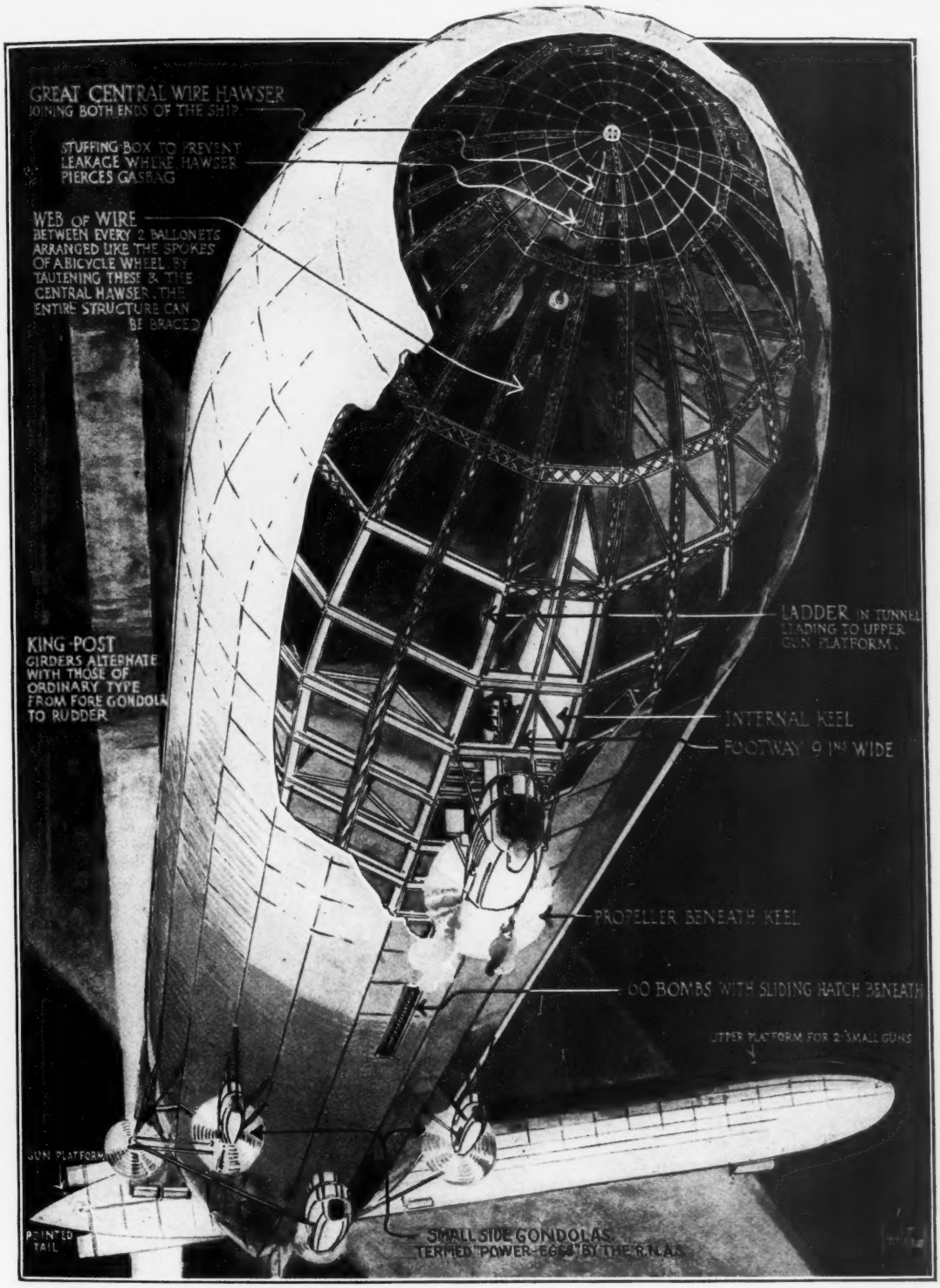
Now it is immediately evident that a Zeppelin thus constructed will always have the same shape no matter at what altitude it may be navigated. What is more, only a rigid Zeppelin can be made large enough to travel at very high speed. Everything depends on speed in a Zeppelin. Moreover, several gas-bags can be punctured without endangering the lives of the navigators.

It is doubtful if any country could start in at once and build Zeppelins. Indeed, England has tried it and failed. Knowledge of the kind that Count von Zeppelin acquired only after the loss of his entire personal fortune in experimenting and only after much financial assistance from the German people and from the German government is not gained over night. A nation cannot merely copy fallen Zeppelins and hope to succeed. It must do original thinking.

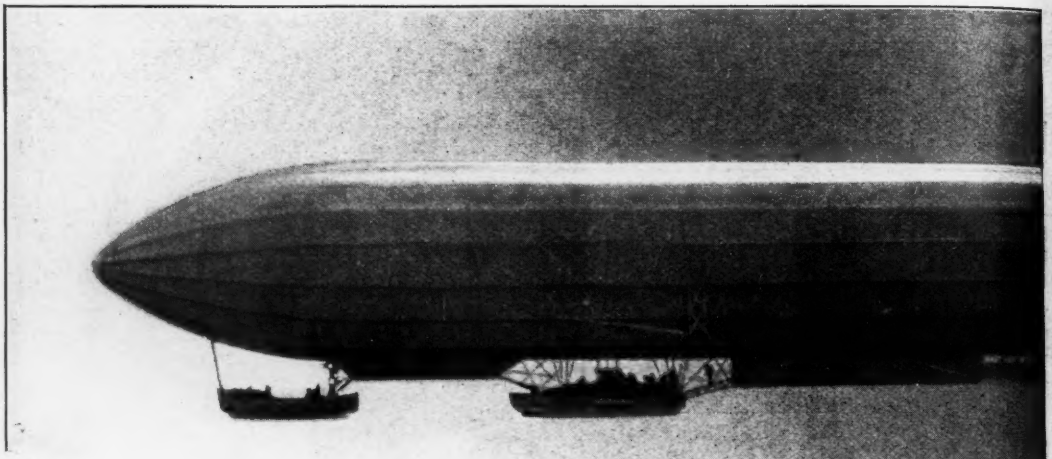
Is the Zeppelin the Surviving Type?

It is still much too early to write the aeronautic history of the present war. This much, however, is certain: With the exception of very small British motor balloons, called "convertible aeroplanes," and suitable only for short patroling journeys in fair weather, the Zeppelin is the only dirigible type that has survived the test of warfare. It seems to have totally eclipsed even the German non-rigid and semi-rigid airships. The war has apparently proved that speed is the life and soul of a dirigible, and speed the Zeppelins certainly have when it is considered that they are capable of making as much as sixty miles an hour against a twenty-mile wind and are on the

For All Its Bulk, a Zeppelin Has Not Much Substance

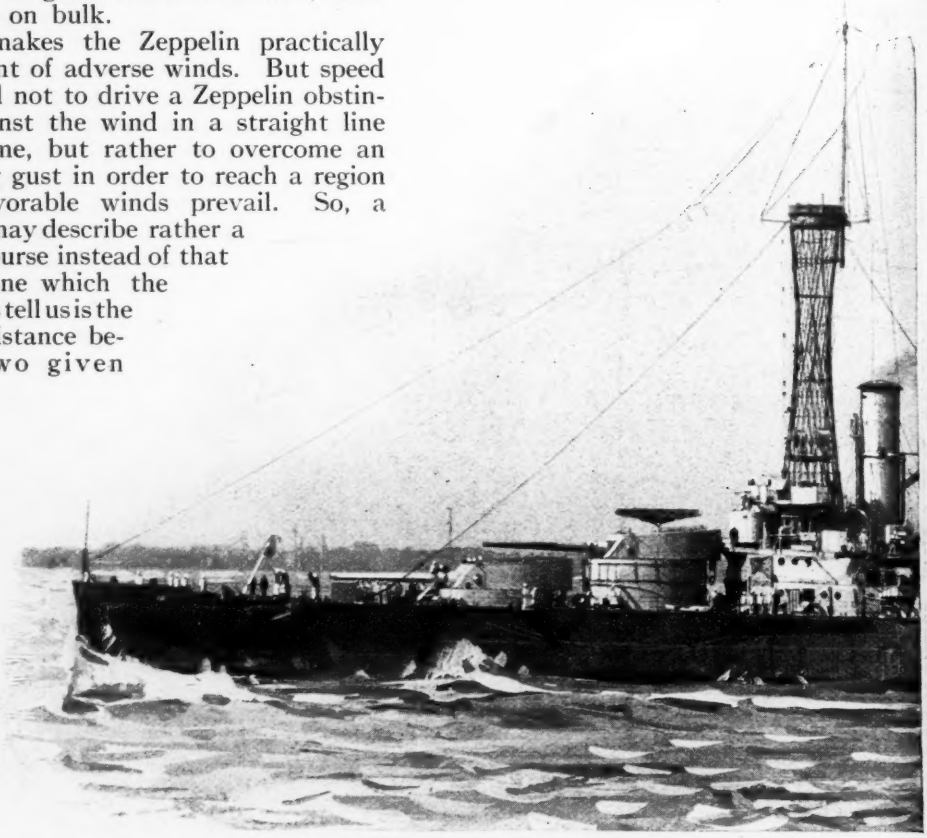


A broken-away view of a modern Zeppelin which gives a good idea of its internal construction. In the Zeppelin the gas is confined in about seventeen independent bags which are contained in a long cylindrical frame. A number of the bags may be punctured, but the balloon will still be buoyant enough to carry its navigators to safety and will retain its shape at any altitude

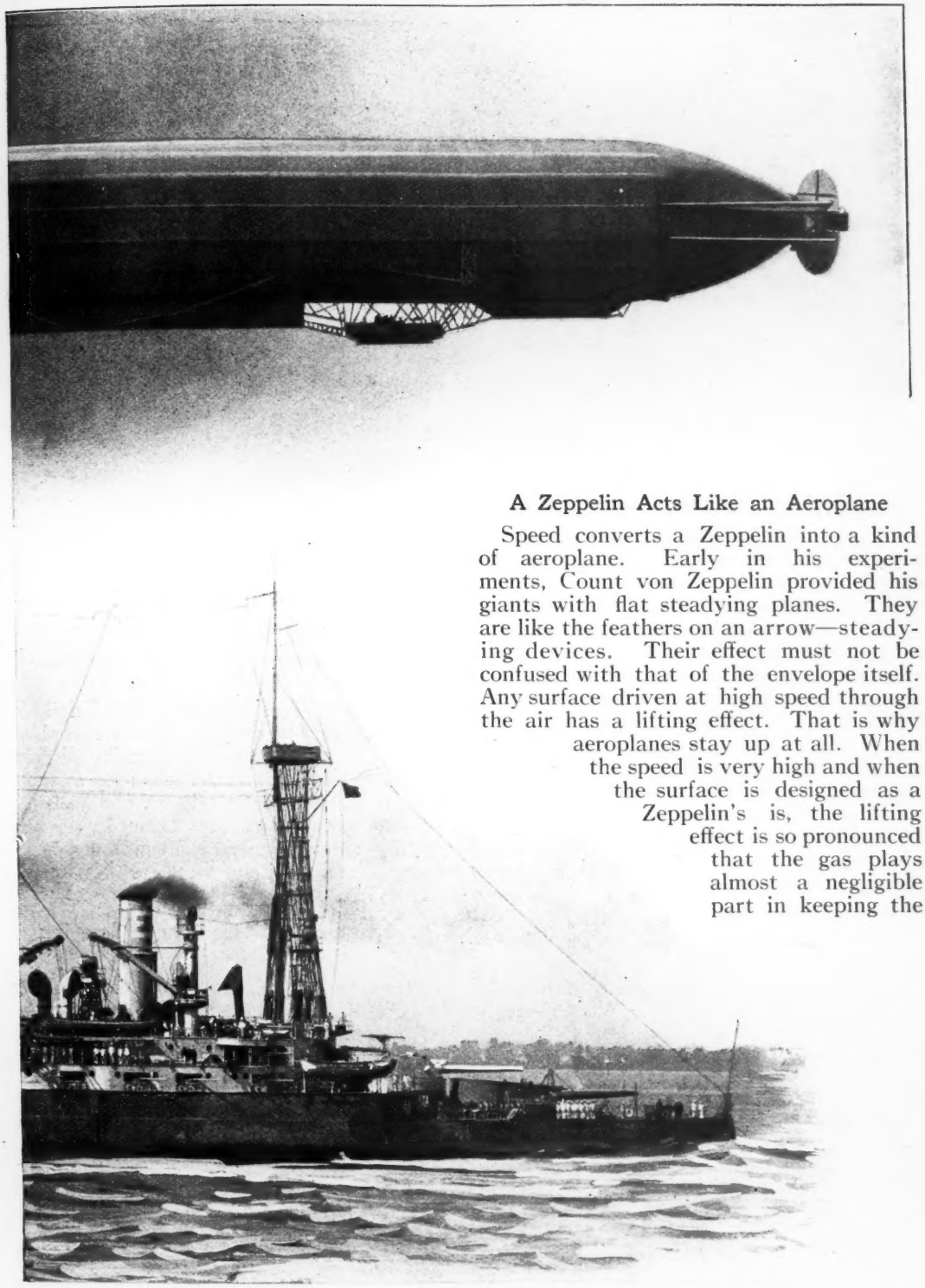


whole as fast as racing aeroplanes. Next in importance to speed, come great carrying capacity and great radius of action, both dependent on bulk.

Speed makes the Zeppelin practically independent of adverse winds. But speed is essential not to drive a Zeppelin obstinately against the wind in a straight line all the time, but rather to overcome an interfering gust in order to reach a region where favorable winds prevail. So, a Zeppelin may describe rather a devious course instead of that straight line which the geometries tell us is the shortest distance between two given points.



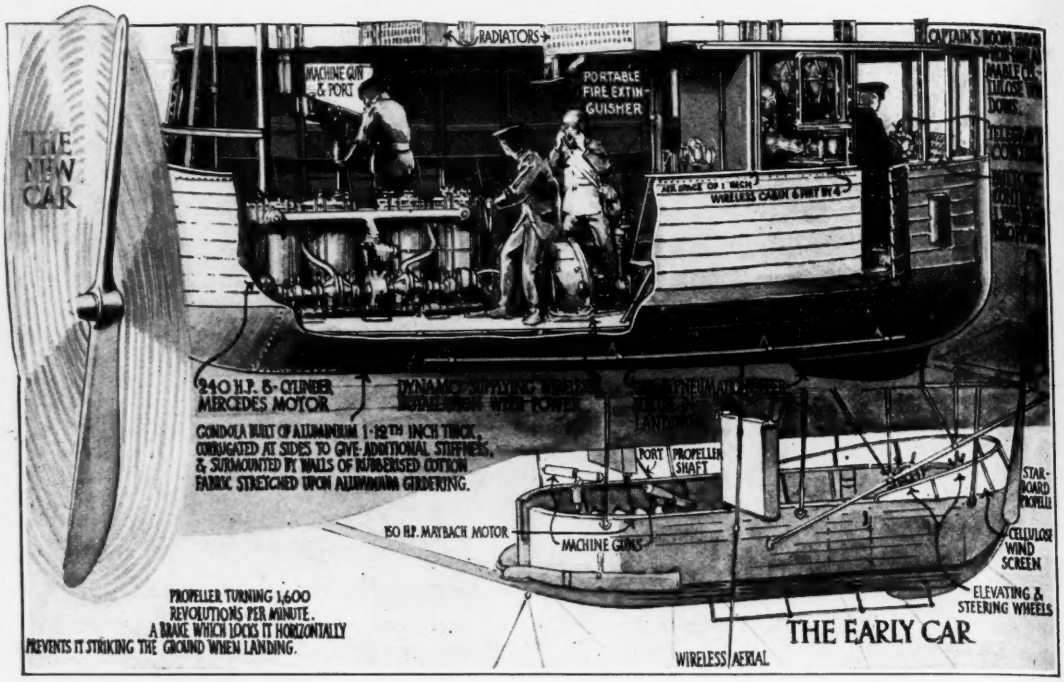
In this picture a Zeppelin is placed above the United States superdreadnought Texas. The comparative sizes have been carefully maintained. The Texas has an over all length of 573 feet, the latest Zeppelin is 670 feet long. But the battleship is more powerful



A Zeppelin Acts Like an Aeroplane

Speed converts a Zeppelin into a kind of aeroplane. Early in his experiments, Count von Zeppelin provided his giants with flat steadying planes. They are like the feathers on an arrow—steadying devices. Their effect must not be confused with that of the envelope itself. Any surface driven at high speed through the air has a lifting effect. That is why aeroplanes stay up at all. When the speed is very high and when the surface is designed as a Zeppelin's is, the lifting effect is so pronounced that the gas plays almost a negligible part in keeping the

A Zeppelin can drop bombs on the Texas all day without doing any more damage than blowing away the unarmored superstructure. She is armed with machine guns to ward off attacking aeroplanes and she carries a powerful wireless set for long-range communication


THE NEW CAR
RADIATORS
MACHINE GUN & PORT
PORTABLE FIRE EXTINGUISHER
240 H.P. 6-CYLINDER MERCEDES MOTOR
GONDOLA BUILT OF ALUMINIUM 1-12TH INCH THICK, CORRUGATED AT SIDES TO GIVE ADDITIONAL STIFFNESS, & SURMOUNTED BY WALLS OF RUBBERISED COTTON FABRIC STRETCHED UPON ALUMINIUM GIRDERING.
PROPELLER TURNING 1,600 REVOLUTIONS PER MINUTE. A BRAKE WHICH LOCKS IT HORIZONTALLY PREVENTS IT STRIKING THE GROUND WHEN LANDING.
150 H.P. MAYBACH MOTOR
MACHINE GUNS
PORT PROPELLER SHAFT
STAR-BOARD PROPELLER
CELLULOSE WIND SCREEN
ELEVATING & STEERING WHEELS
WIRELESS AERIAL
THE EARLY CAR

The early car of the Zeppelin and the new car are here contrasted. The new car is far more comfortable. It is roofed over probably to prevent the possibility of a chance spark reaching the gas envelope above rather than for any protection required by the navigators. Note the positions of the machine guns near the motor, which is unfortunate because of the motor vibration

craft aloft. The gas in a Zeppelin (but not in other types because they are too slow) is required for buoyancy only when the ship is standing still or merely drifting. Down on the ground, in starting and landing, the gas is a blessing.

By giving his titanic structures a speed greater than that of most railway trains, Count von Zeppelin has at one stroke removed all the fatal imperfections of balloon support—the fluctuations in displacement resulting from the chilling effect of high altitudes on confined gas as well as the changes in volume that take place in rising and falling.

I have spoken at some length about speed and the aeroplane lifting effect of a Zeppelin because the entire future of the dirigible depends on its transformation when in motion into an efficient aeroplane. Moreover, the Zeppelin is regarded both in Great Britain and in the United States as an out-and-out dirigible. Only recently an illustrated London weekly attempted to demonstrate the harmlessness of a Zeppelin by graphically depicting its diminishing gas lift at increasing altitudes. The powerful aeroplane lift was not considered at all! Similarly, in a presumably authoritative American review of European dirigibles, published just before the war, the aeroplane lift of a Zeppelin was considered negligible. And yet the Germans themselves constantly harped upon it! In one German official publication, for example, it was plainly enough stated that without aeroplane lift, a Zeppelin would be an impossibility.

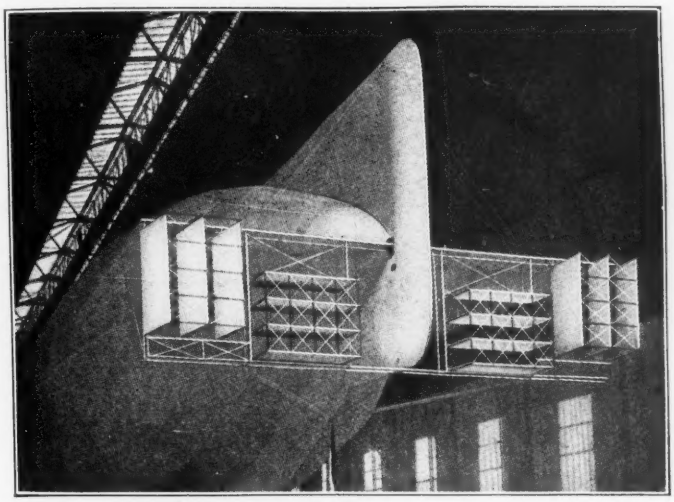
Advantages of Speed and Carrying Capacity

Next to speed, the most astonishing feature of a Zeppelin is its carrying capacity. That has its merits, especially in a fighting craft. It means that much cargo can be supported at high altitudes and that the favorable swift upper currents, prevailing chiefly at high altitudes, can be utilized for speedy journeys. It costs thousands of dollars to inflate a Zeppelin with hydrogen gas. Unlike other airships a Zeppelin need not be inflated to the full at low altitudes, but with just enough to allow for complete expansion at high altitudes. No loss is incurred to relieve pressure.

The third advantage which accrues to a Zeppelin because of its great size, the advantage of enormous radius of action, is of

minor importance. Radius of action has simply the military advantage of rendering it unnecessary to alight at sea or in the enemy's country for lack of fuel or gas.

The frame of a Zeppelin is built like a bridge. But no one would dare concentrate at one point all the load that a bridge is designed to support. The load on a bridge and the load carried by a Zeppelin must be distributed. Hence the new Zeppelins have four cars. The two in the center are each sixteen feet long and the others, placed fore and aft, are thirty feet long. The cars are roofed over in order that a chance spark may not fly up to the gas-bag, with results that may be imagined. There used to be a long well-equipped central cabin between cars into which the crew would retire when off duty. Now, the crews apparently confine themselves to the cars.



Stern view of a Zeppelin showing the vertical rudders, the horizontal rudders, and the lifting surfaces which serve to steady the Zeppelin like the tail feather of an arrow

The Guns and Bombs of a Zeppelin

The most modern super-Zeppelin carries a battery of nine machine guns—six in the cars and three on top of the gas envelope. Two guns are sometimes mounted on the envelope near the bow. This distribution of armament does not seem to make the best use of the possibilities of a Zeppelin as a gun platform, for a Zeppelin is as steady as a rock, except the stations near the motors. Vibrating motors are but poor companions for guns, and the guns on top seem to lack shelter for delicate sighting instruments. Perhaps no other arrangement is possible. It must not be forgotten that for all its bulk a Zeppelin has not much substance. In that respect it may be compared with an immense cloud or with a filigree structure. The vibrating motor cars may be the stanchest gun platforms that can be provided under the circumstances. The passage-way between the cars is certainly too narrow for guns. In view of the British aeroplane victories over the Zeppelins it may well be that Count von Zeppelin's designers have now decided to invest more weight in favorable gun positions. But it seemed wiser to put weight into such strict necessities as a powerful electrical equipment for a dependable long range wireless equipment; into dynamos coupled with six 240-horse-power motors (dynamos used to supply current to the search-lights as well as for illuminating the cars, for heating and for cooking); into a large supply of heavy bombs and strong motors for speed and lift; and above all, into much fuel for remaining aloft many hours.

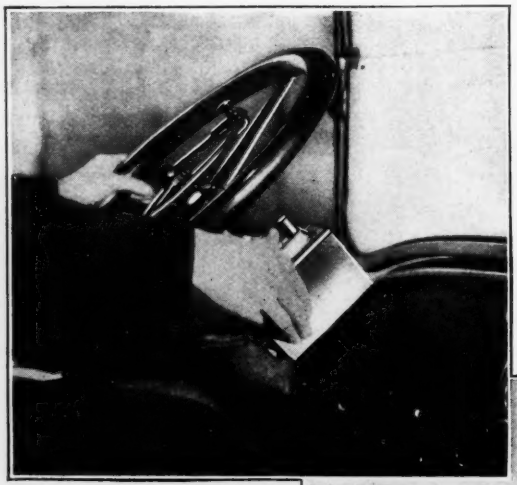
The bombs are carried under the belly of the vessel, like the roe of a fish. Indeed, in military slang, bomb-dropping is called "laying eggs." The bombs are electrically released. Each of the sixty bombs is controlled by a button. When the captain pushes a button a 120-pound bomb drops.

Americans will naturally wonder whether New York or Philadelphia may not be compelled to put out their lights at eight o'clock and conceal themselves. While a Zeppelin undoubtedly could cross the ocean, it could not do so with any great load of bombs. Great as the radius of action of the Zeppelin is, it must remain within navigating distance of its base. And even a Zeppelin would hardly venture upon a bomb-dropping excursion which would entail a voyage of eight thousand miles, at the very least, without replenishing its fuel tanks.

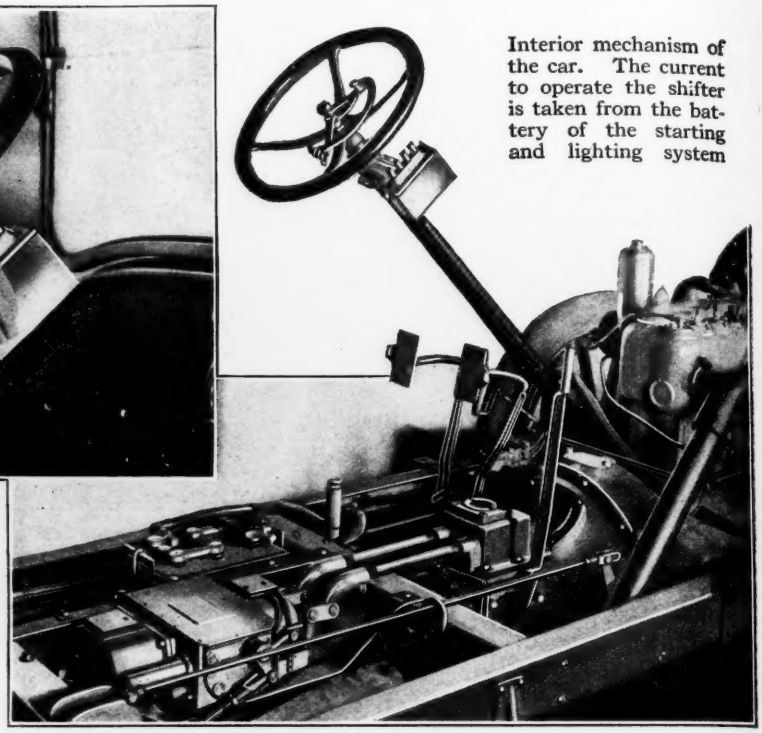
Unlike an aeroplane a Zeppelin cannot alight anywhere with impunity. A *Mauretania* must have her wharf; Zeppelin must have its shed. To be sure a Zeppelin, like a *Mauretania*, can anchor. But she runs risks in doing so.

Shifting Gears Automatically

It is done by electricity, a mere pressure of a button effecting the change

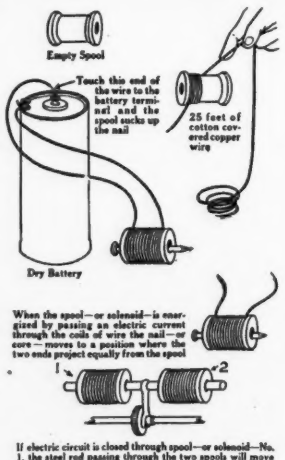


There are four buttons, one for each speed-change gear. As these are pushed the gears are moved into mesh by magnetic attraction



Interior mechanism of the car. The current to operate the shifter is taken from the battery of the starting and lighting system

ONE of the electric gear-shifters now on the market, the use of which enables the gears to be changed by the mere pressure on a button, is operated on the principle of electromagnetism in which solenoids are used. The solenoid is similar in many respects to the common horseshoe magnet except that whereas the energy of the horseshoe magnet is permanent and does not vary, the solenoid exerts its power only when electric current is passing through its coil. As shown in the accompanying sketch, the simple solenoid consists of a spool around which is wound a coil of wire, the ends of which are attached to some current source. A metal rod inserted within the hole of the spool will move to a position where both ends project equal distances from the ends of the spool if current is passed through the coil of wire.


Empty Spool
Touch this end of the wire to the battery terminal and the spool sucks up the nail
25 feet of cotton covered copper wire
Dry Battery
When the spool—or solenoid—is energized by passing an electric current through the coils of wire the nail—or core—moves to a position where the two ends project equally from the spool
1
2
If electric circuit is closed through spool—or solenoid—No. 1, the steel rod passing through the two spools will move to the left, moving gear to the left. If circuit is closed through solenoid No. 2, rod and gear will move to the right

A simple solenoid with rod, one of which is provided for each of the change-speed gears

This is the principle of the electromagnetic gear shift, one solenoid being provided for each of the change-speed gears in the transmission. A rod with an arm carrying the gear is inserted in the solenoid. Current passed through the solenoid causes the rod and the gear to move back or forth, in or out of mesh with other gears which transmit the power to the driving wheels. In the ordinary gear set with three speeds forward and one reverse, four speeds in all, four solenoids are used. These are arranged in two sets of two each as shown at the bottom of the accompanying sketches. Steel shafts carrying gears on arms are placed inside of the solenoids, and as

the current is sent through one or the other of them the shafts and the gears are moved in or out of mesh by magnetic attraction.

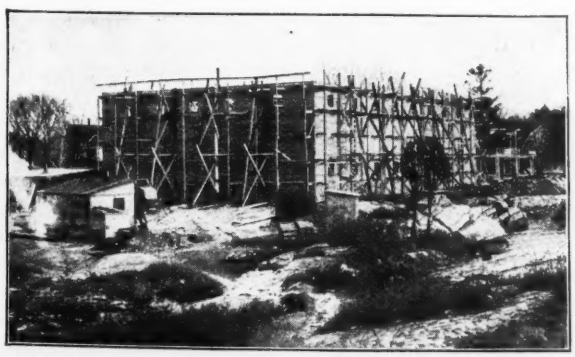
Each solenoid is wired to a numbered bottom in a small case attached to the steering column directly under the wheel, within easy reach of the driver. There are four buttons, one for each speed-change gear, and as these are pushed, the current is sent through the solenoids as desired, thus moving the gear into mesh. Two gears cannot be thrown into mesh at the same time, as the circuit between each solenoid and its corresponding button is not closed until the clutch pedal is depressed. For this reason the gear into which the driver wishes to go may be selected some time in advance and the change made in an instant by simply depressing the clutch pedal and then letting it spring back again. The current necessary to operate the shifter is taken from the battery of the regular starting and lighting system now used on most cars.

A simple stair-guard which prevents careless people from falling down stairs and into open shafts

Building a House to Protect a House —How One Wealthy Man Fooled the Weather

YOU can even make the weather behave, if you are willing to spend the money. If your contractor is facing serious delays in the way of bad weather all you need do is to build an extra house to keep the weather out.

The accompanying illustration shows a temporary structure built around a home erected at Eastern Point, near New London, Conn., by Julius Fleischman. For a while the weather bothered the contractor and it looked as if the home wouldn't be finished at all, whereupon the owner, taking the situation in his own hands, decided to eliminate the weather altogether by building a house to protect the house. Then the men were able to proceed.



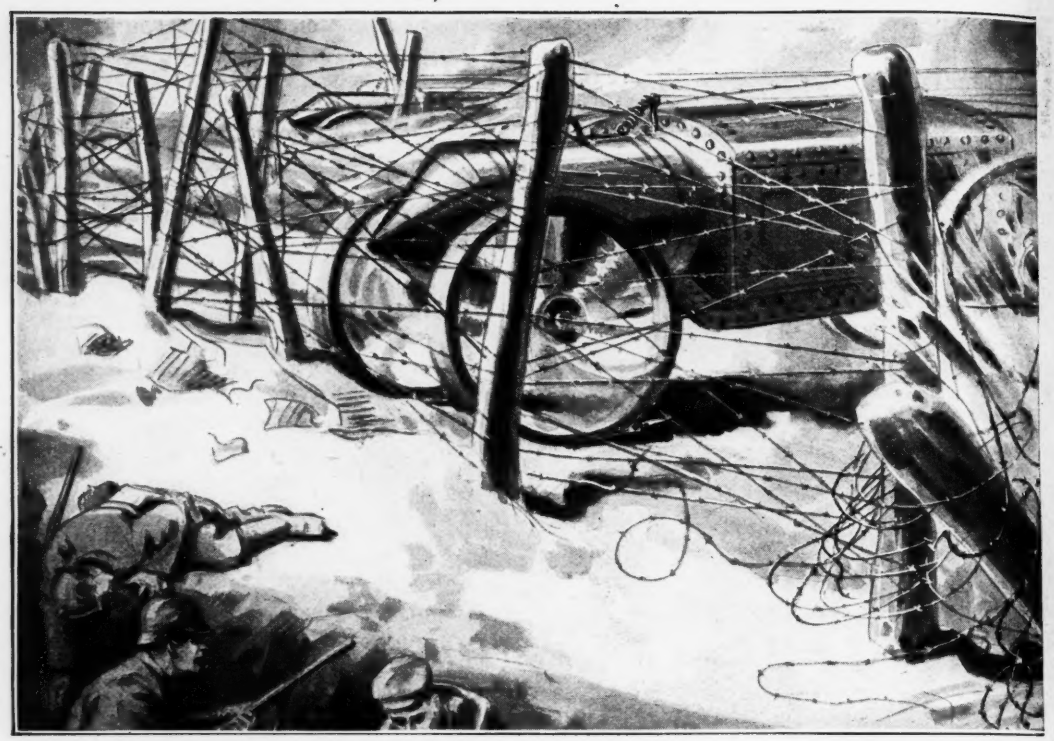
The weather interfered with the workmen. So, a protecting structure was erected around the house

A Simple Elevator Guard Which Makes You Watch Your Step

A GUARD invented by Harry Howe, of Rockford, Illinois, and illustrated above, acts both as a warning and as an obstruction to a person approaching an open elevator shaft or stairway.

The device, which may be readily attached to one side of the stairway in the home, consists of a bracket and a guard member. The bracket is equipped with guides which automatically keep the guard member in normal position when it is not being operated.

In going down the stairway or into the passageway, it is necessary only to raise the guard member above the stop portion on the guide, after which, by slight pressure, it follows the guide, swings to a raised position and returns to the normal position as soon as the person has passed. In coming out of a stairway, a slight pressure of the arm or body swings the guard to a raised position, out of the way.



Why spend great sums in bombarding the enemy's entrenched position with artillery when a fleet of torpedo automobiles, each carrying a charge of high explosive, could be launched with

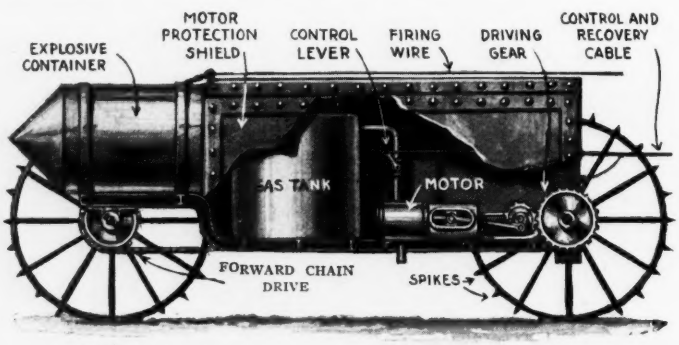
The Torpedo Car—It Destroys Trenches

Also it takes the place of artillery in preparing the way for infantry attack

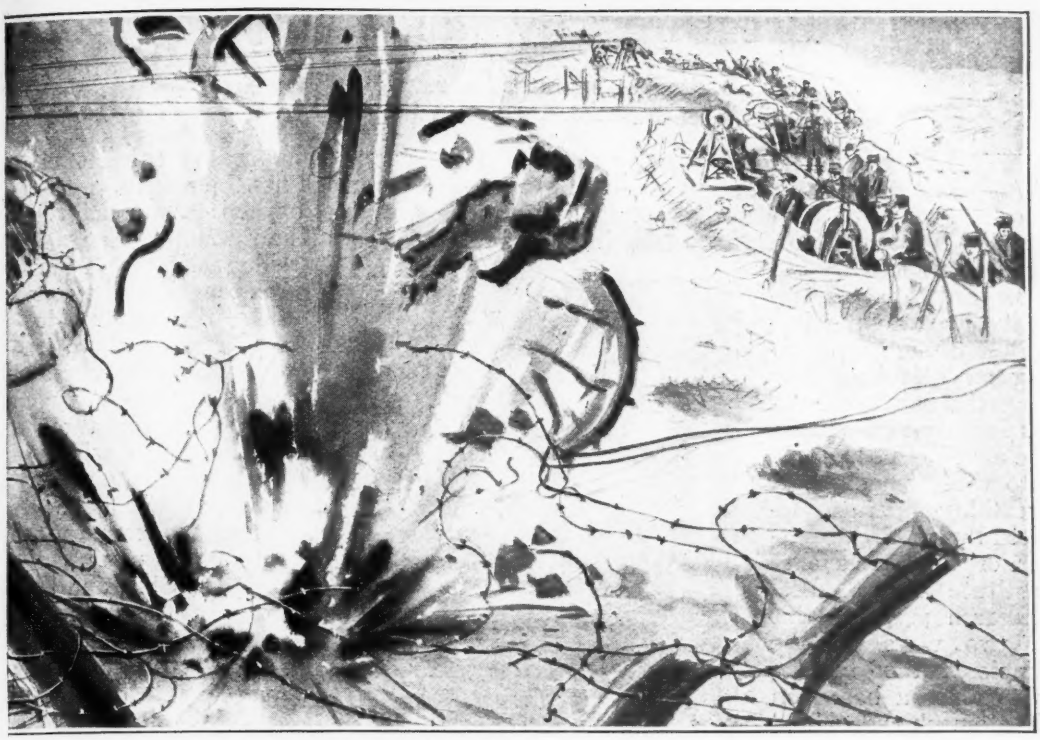
A WELL-DIRECTED bombardment ("artillery preparation" is the polite military term) preceding an infantry attack obliterates breastworks and barbed-wire entanglements, and literally blasts the enemy from his entrenched position. From experience under such a hail has come the fighting man's dictum, "Better to face a whole regiment than brave an hour's artillery fire!"

But even though the use of modern artillery has worked a revolution in battle practice, preparing the way for an infantry charge entails a staggering cost. For that reason inventors have tried, and indeed still are trying, to substitute some agency which will replace the big guns and do their work cheaper but no less efficiently.

The device illustrated, which may be called a torpedo car, because it is nothing more than a torpedo mounted on an automobile chassis, is an attempt to relegate artillery to the scrap heap and substitute in its stead a cheap,



What the torpedo car looks like. Note that the control cable regulates the speed of the machine and that the firing wire sets off the explosive



unerring accuracy and deadly effect against the barbed-wire entanglements? One of these machines would cost but one thousand dollars; a modern naval torpedo costs seven thousand dollars

effective means of destroying the enemy's entrenchments. So far as the actual manufacturing cost goes, one of these torpedo cars could be built for one thousand dollars, whereas the modern naval torpedo represents an outlay of seven thousand dollars. This, in itself, is an important factor in its favor. Whether or not the torpedo car could withstand the concentrated fire of the defending force, rests entirely upon the distance over which it would have to travel and the material of which it is made.

Briefly, the torpedo car consists of a torpedo carrying several hundred pounds of high explosive mounted on a chassis. It may be propelled either by gas, steam, compressed air or a storage battery and electric motor, all depending on its contemplated use and the estimated range of action.

But the most important feature of the car concerns the method by which it is guided and fired. This is done by means of cables and wires in the hands of the attacking party, as illustrated on this page. The control cable is attached to a valve in the supply pipe connecting the cylinders of the engine with the boiler, operating the speed of the car. The charge is fired by means of a wire attached to the trigger.

If it is found that the torpedo cannot reach the enemy because of rough ground, the control cable may be used to close the valve and to draw the machine back to the trench, for aiming it in a new direction. A windlass is provided for this purpose. Spiked wheels insure traction.

The torpedo car is provided with a shield of sufficient strength to bear up under rifle fire, as there is little likelihood that the enemy could train artillery on it in the brief period during which it is exposed and the high speed with which it is driven.

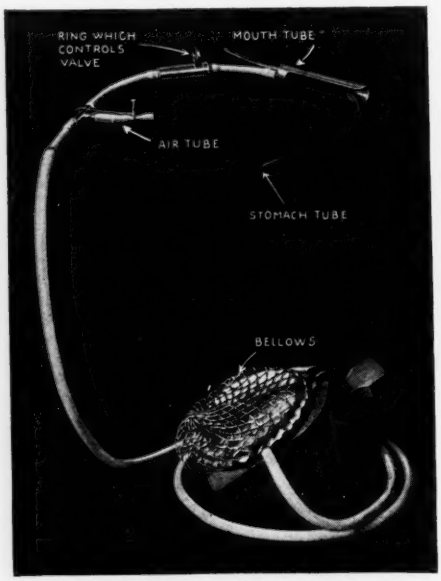
In carrying out an offensive campaign the inventors, Victor A. Villar, of New York, and Stafford C. Talbot, of London, plan to supply an attacking force with a number of these torpedo cars. At a given signal these war implements, suitably spaced apart according to the length of the enemy's front to be attacked, are released. They travel toward the enemy's entanglements and obstructions with astonishing speed. When they have reached certain desired points, the torpedoes which they carry are automatically exploded by pulling the wires attached to the triggers, and everything within a radius of two hundred feet is blown to pieces, including the machines.

Breathing by Machinery

Dr. Meltzer's apparatus has saved the lives of many overcome by gas in the trenches

WHEN a man is overcome by poisonous gases or is shocked into insensibility by electricity, he may usually be saved if artificial breathing is at once induced.

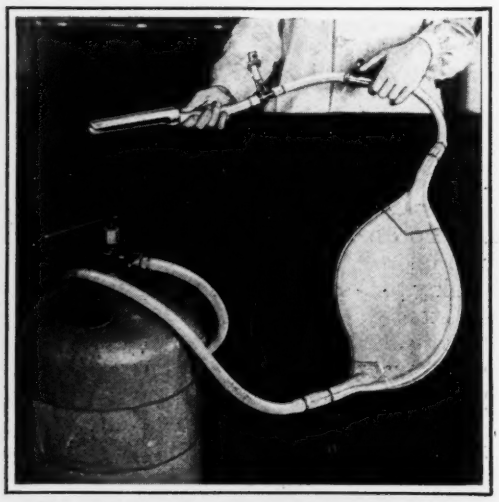
In order to accomplish the effects of natural breathing by pumping oxygen into the lungs through the throat, care must be taken that the air does not escape into the stomach. A breathing apparatus devised by Dr. S. J. Meltzer of the Rockefeller Institute for Medical Research prevents this in two ways. The simpler method he uses is to place a board on the stomach and to hold it firmly in place by means of straps which are passed around the body. The board exerts sufficient pressure to make the entrance of air into the stomach impossible. The other method employs a tube inserted in the stomach to remove any air that may enter during the process.



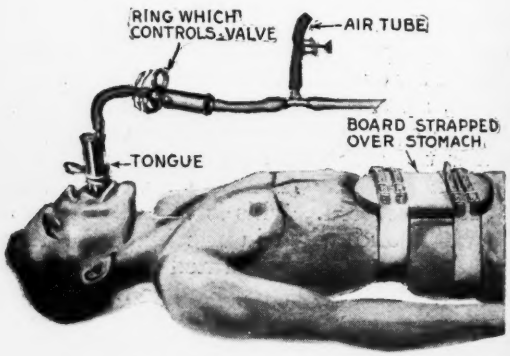
The apparatus consists of a throat tube, a stomach tube and a bellows, connected with the oxygen tank

Dr. Meltzer's apparatus consists of a throat tube which fits the mouth, preventing the escape of oxygen; a stomach tube, and a bellows. The throat tube has a flat side which rests against the tongue, and a round side—the upper side—which reaches to the wall of the throat and prevents the oxygen from escaping through the nose by closing the entrance to the air passages in the nose. A rubber hose connects the throat tube with the bellows or bag and this, in turn, is connected with the oxygen tank.

The stomach tube may be attached to the end of the throat tube or not, as the operator desires. When it is not used, the hole in the throat tube to which it is connected may be closed by a plate. Attached to the throat tube is a valve which regulates the passage of oxygen into and out of the lungs. The valve is controlled by a ring, which when moved to the right causes the oxygen to be forced into the lungs; when moved to the left it causes the oxygen to be expired from the lungs. The necessary oxygen is given by the bellows.



The throat tube has a round upper side which prevents the oxygen from escaping



In case of failing circulation the board on the abdomen will raise the blood pressure

This Fireman's Suit Is Made of Real Water

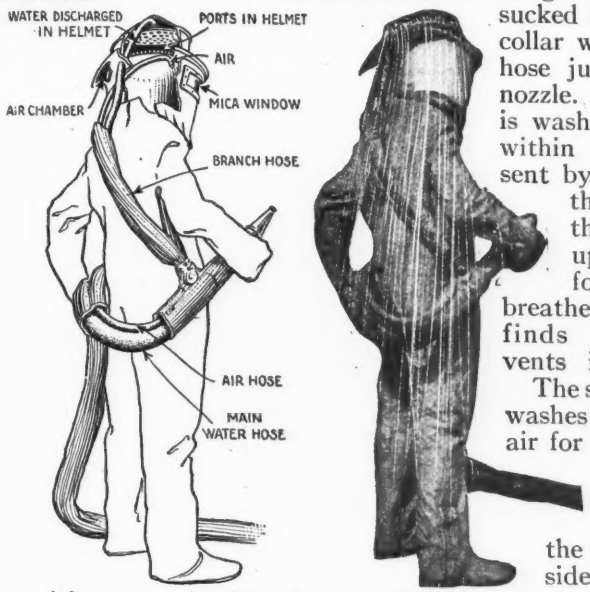
THE Cincinnati fire department has been testing a new safety dress for firemen. The man who wears it can stand right in the midst of flames. He need not fear the glowing embers around his feet. He can walk into a fire and it will dwindle away and go out around him.

The dress is made of fireproofed canvas of two thicknesses between which water flows constantly. The water enters by means of a perforated brass tube which encircles the neck between the two thicknesses of canvas and flows down between the layers through the arms and legs, finding exits at the finger tips and around the soles of the feet.

Water flowing only between the two thicknesses of canvas would not offer complete protection to the wearer. To keep him cool and comfortable while standing in the hottest fire, two brass perforated tubes encircle the helmet and give him a constant shower-bath from the outside as well as within the folds of the uniform. This not only keeps him from becoming over-heated but also extinguishes the fire around him.

In this air-tight water-bathed uniform some provision must, of course, be made for ventilation. The air supply arranged for cannot give out so long as water concontinues to flow through the hose held in the fireman's hand. It comes from the surrounding atmosphere, no matter how much smoke, flame or gases are in it. It is sucked into a patented collar which fits on the hose just back of the nozzle. The smoky air is washed and purified within the collar and sent by the pressure of the water flowing through the hose, up into the helmet for the fireman to breathe. The foul air finds exit through vents in the helmet.

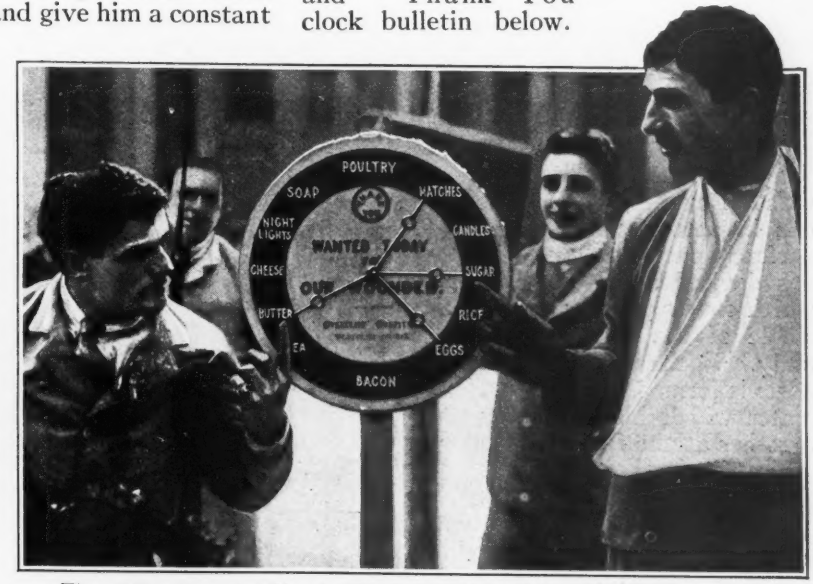
The same collar which washes and purifies the air for the fireman also has the water hose connection which supplies the shower baths inside and outside of the uniform.



A fireman wearing this uniform stood in flaming wood for ten minutes without discomfort

How One Hospital Gets Its Necessary Supplies

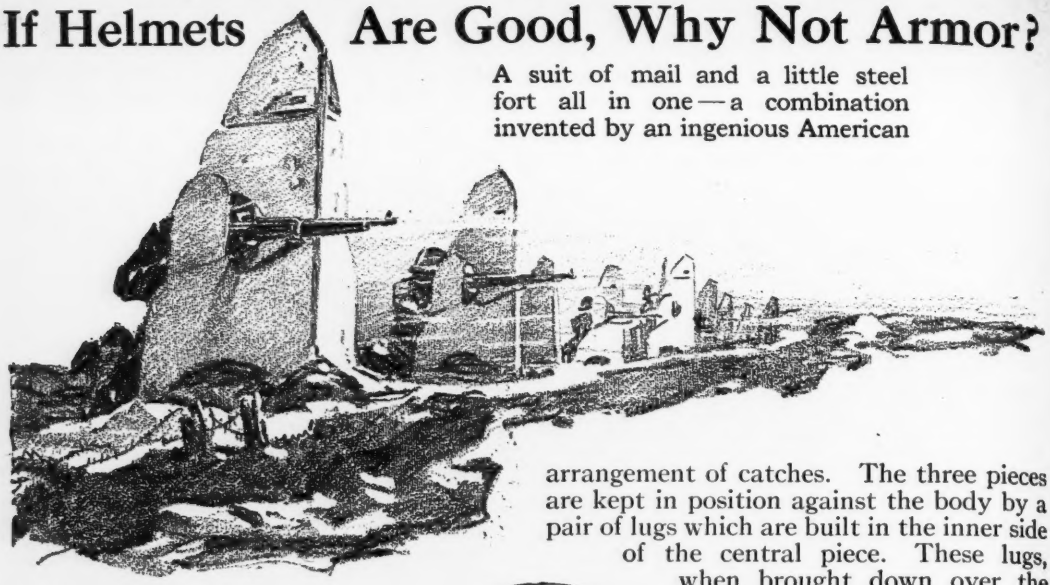
AT the Overcliff Hospital, Westcliff-on-Sea, England, there is a feeling that the public only wants to be taken into the confidence of the public institutions in order to offer efficient co-operation. So the hospital authorities have introduced the "Want" and "Thank You" clock bulletin below.



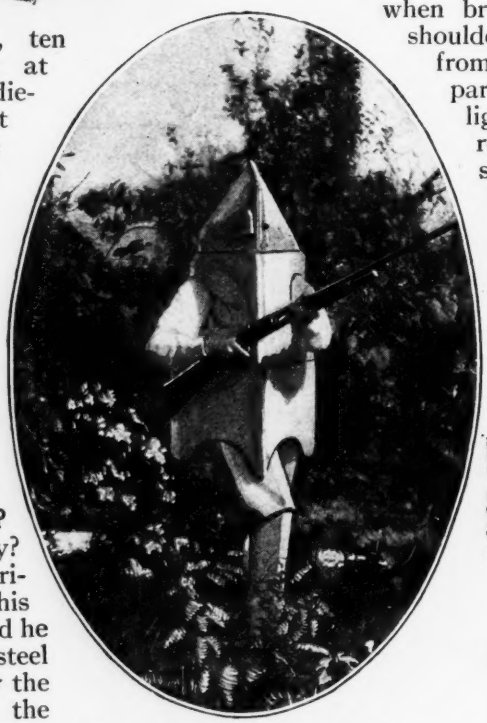
The "Want" and "Thank You" bulletin clock which the hospital authorities of Overcliff Hospital, England, have placed in a conspicuous place on their campus to inform the public of their needs

If Helmets Are Good, Why Not Armor?

A suit of mail and a little steel fort all in one—a combination invented by an ingenious American



NO one suspected, ten years ago, that at least part of a medieval knight's equipment would prove serviceable in modern battles. Yet all the fighting nations, following the example set by the French, have supplied their men with steel helmets. Since the helmets have unquestionably proved their merit, particularly as a defense against bursting shrapnel, why not go a step farther? Why protect only the head? Why not the whole body? Otis L. Boucher, an American inventor, believes this perfectly practicable, and he has devised a suit of steel which covers practically the whole of the front of the body. Each one of its seven parts is formed by two steel plates which hinge sharply together at the front. It is seen at once, therefore, that since the plates are placed at an angle the bullets of an enemy are more likely to be deflected than to kill.



The parts of the armor can be detached and the three larger pieces of the body folded along the edges

PIVOTED SHUTTER WITH SMALL OPENING
PIVOTED HELMET MAY BE THROWN BACK
LARGE OPENING PERMITTING USE OF FIELD GLASSES
HINGED BREAST PLATE
PADDED SUPPORT OF BREAST PLATE ON SHOULDER
SHUTTER HANDLE
SHUTTER
BELT SUPPORTS THIGH SHIELD
ARMOR BENT AT AN ANGLE OF 15° TO LINE OF FIRE
PIVOT
STEEL CAP PREVENTS EXPOSURE OF KNEE AS SHIELDS SEPARATE WHILE ADVANCING
LOWER LIMB SHIELD
CUT AWAY TO CONFORM TO FOOT

Details of the armor. The head and body part can be lifted off with a single swift movement

The main part of the armor protects the head and body. It is made in three pieces held closely together by a clever arrangement of catches. The three pieces are kept in position against the body by a pair of lugs which are built in the inner side of the central piece. These lugs, when brought down over the shoulder, prevent the armor from sliding off. The head part or helmet is made of lighter steel than the rest, and it is padded inside for comfort. The helmet is hinged to the central piece so that it can be raised and thrown back whenever it is desirable,—and sufficiently safe.

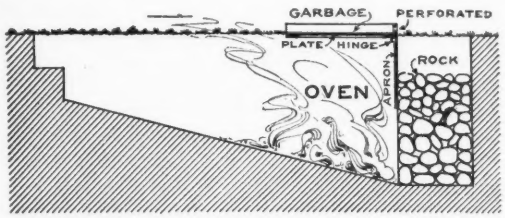
Each of the leg pieces is made in two parts, and each is hinged at the knee and strapped in place. The pivot-joint allows the knee to be bent to provide for perfect freedom of action in crouching or crawling.

General Typhoid—an Army's Most Formidable Enemy

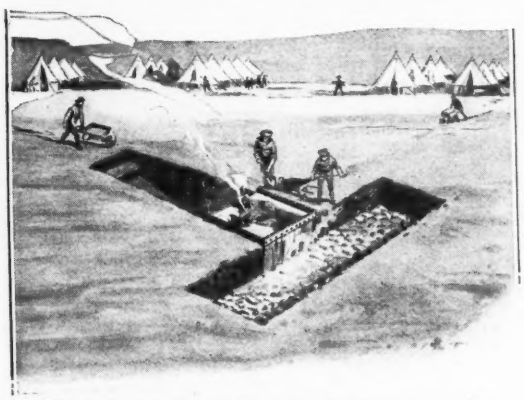
EVEN in the present war, for all our boasted sanitation, disease carries off many a man. General Typhoid has dirt and germs for his allies—and they never fail him. To fight him, an army and its camp must be clean. So, an apparently trifling problem like refuse disposal, is as important as supplying munitions.

Because an army piles up tons of rubbish and garbage every day, the equivalent of a municipal street cleaning department and board of health is needed. The finest purifier is fire. To the flames, then, all wastes are consigned.

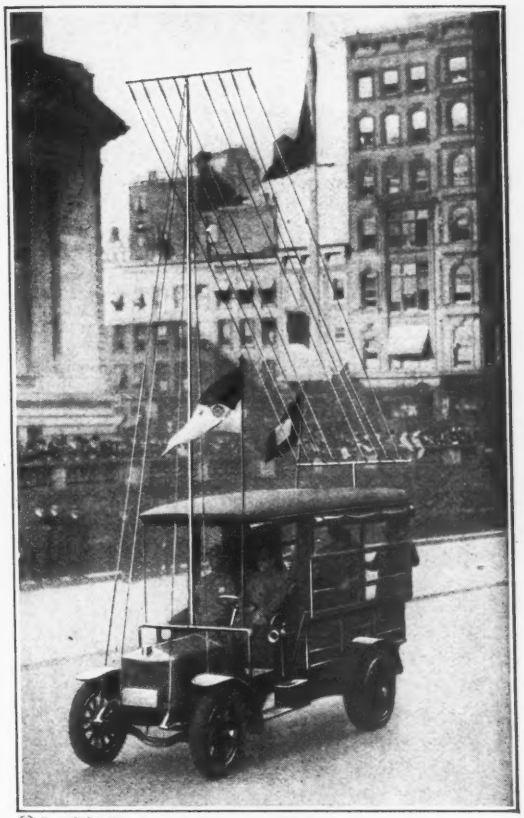
A United States army officer has recently proposed that as small a group as a battalion of men should be supplied with its own incinerator and its own men to look after the burning of its food wastes. The incinerator approved for this purpose is built in the ground in the shape of a flat T-trench. In the oven of the "T," is the fire which heats the rocks placed in the head of the "T." The refuse itself is burned on a steel plate placed directly over the oven. The liquid of the refuse drains off from the plate and trickles through holes in the plate, down over the hot stones beneath.



This incinerator can be built anywhere and disposed of quickly when no longer needed



The refuse is burned on steel plates over the oven and the liquid drains off through the rocks



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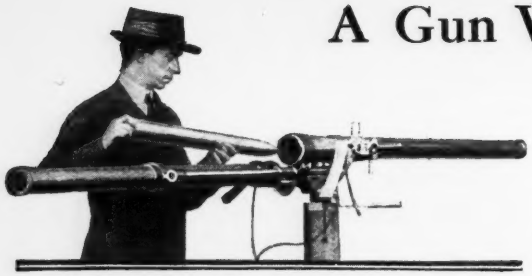
The automobile wireless communication outfit of the New York city Police Department

New York Police Department Uses Motor-Truck Wireless

WIRELESS telegraphy from moving trains was shown to be practical some years ago, but it remained for the Police Department of New York city to build a wireless truck that could communicate with headquarters while driving through the streets. A complete radio outfit is mounted within the body of the automobile, and two masts to support the aerial wires set up at front and rear. Power to drive the transmitter is taken from the gasoline motor which propels the truck.

Our photograph illustrates the mobile wireless station, as it appeared in the recent police parade, passing the Public Library at Fifth avenue and 42nd street. Although the city is run through and through with telegraph wires connecting the various police stations, the wireless installations at Headquarters and the police camps are necessary in case of emergency.

A Gun Without a "Kick"



It fires a shell weighing from 12 to 14 pounds at a muzzle velocity of 1175 feet per second. The recoil action is overcome by discharging a charge of shot and vaseline from the rear

It is based on the theory that action and reaction are equal and in opposite directions

By Edward C. Crossman

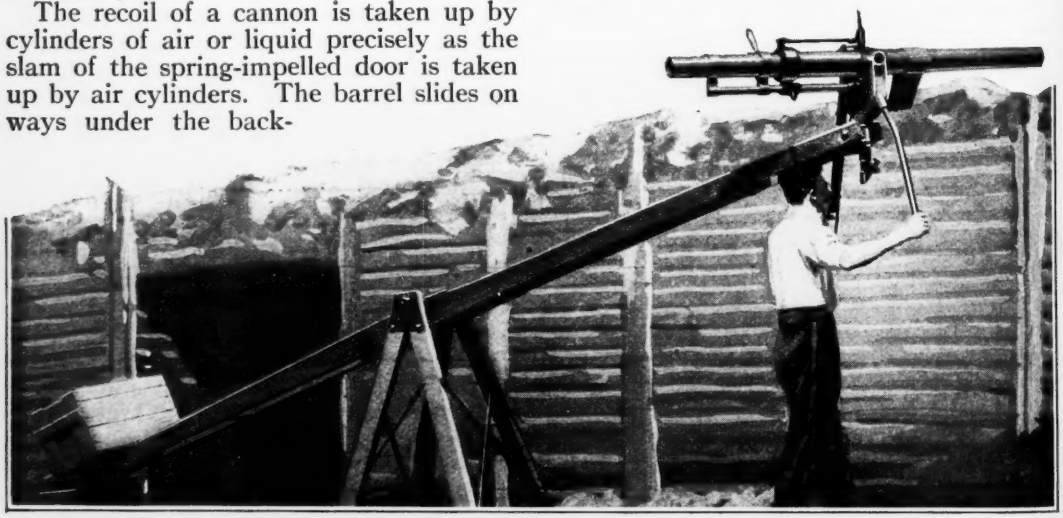
A BULLET in a gun, being lighter than the weapon, gives way first when the powder is fired, and travels faster; but the gun of which the breech-block is a part, travels the other way just the same. The nearer the weight of the gun is to the weight of the bullet or shell, the faster it travels, and the heavier, therefore, is the "kick" of the gun. In theory, if the gun were the same weight as the bullet they would fly in opposite directions at the same rate of speed.

Now if you put a charge of powder in the *middle* of a gun barrel, and put a bullet of the same weight at one end of the charge as a bullet placed at the other end of the charge, then touch her off, the gun won't kick at all. The two bullets will merely go off in opposite directions. The expansive force of the gas has operated in both directions as usual, but there was nothing to move the gun itself. So much for a principle well known in gunnery for a hundred years.

The recoil of a cannon is taken up by cylinders of air or liquid precisely as the slam of the spring-impelled door is taken up by air cylinders. The barrel slides on ways under the back-thrust of the gas, and its motion is checked by the cylinders and the perforated pistons within. Old types of guns ran back every shot, and the naval crews had to tail on to the tackle and run the gun back into battery after reloading, just as the field artillerymen used to run back their pets after each shot. This was slow, and necessitated resighting—termed "relaying" in gunnery parlance—for every shot. The use of recoil cylinders stopped all this.

Presently there arose the need for a bigger gun for aeroplane fighting, both for the other planes, and for the things of land and water the planes didn't like. Planes are cranky things so far as stability is concerned, and it was obvious that you couldn't have a gun kicking around in one of them without disturbing things. It was equally obvious that you couldn't put a two or three hundred-pound gun and recoil mechanism in a plane in which the last ounce of weight was figured, because that meant cutting down speed and raising plane area.

Then came the man who could apply a wellknown principle to a wellknown need. He is Commander Cleland Davis, U. S. N., Retired. If, he figured, a gun with a



The throw of a lever rolls the rear barrel and exposes the breech end for the reception of the ammunition. Another throw of the lever returns the rear barrel to its former position and locks it

powder charge in the center of the barrel, and a bullet at either end of the charge didn't kick, then a still bigger gun with a shell in the place of the bullet, and an equal weight of fine shot or something of the sort at the other end of the charge, wouldn't kick, either. So came about the wonderful kickless gun, a cannon firing a three-inch shell with the velocity of 1,000 feet a second, and yet so light and devoid of kick that a man has fired one in his bare hands.

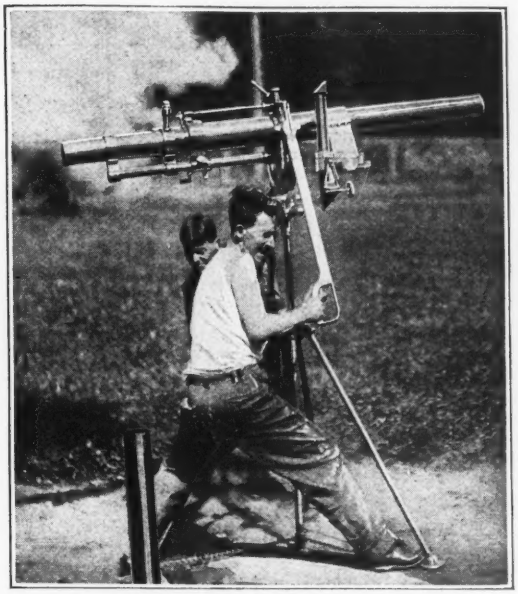
There's nothing to it but what I've told you—the projectile ahead of the powder, a charge of shot of weight equal to the projectile behind the powder, two barrels joined at the charge, and no breech-closing apparatus save that which joins the two barrels after loading. When the charge explodes, shell goes one way, fine shot goes the other, down its own barrel. The gun cannot kick because there is no resistance in the gun to the powder pressure, save the chamber walls at the side. The wall pressure, being the same all round, doesn't tend to move them at all. The kick is all given to the shot, which is driven out of the back barrel and which falls to the ground as harmlessly as a charge from a shotgun.

In the gun as now made, the barrels are made of the lightest, thinnest sort of vanadium steel, the strongest sort of metal. A man can easily pick up and carry the whole gun.

The throw of a lever at the center of the gun rolls over the rear barrel and exposes the breech end of the rifle barrel for the reception of the fixed ammunition, which comes in the form of a very large cartridge with a 3-inch shell in it. This contains powder charge, shell and shot. Another throw of the lever returns rear barrel to position and locks it. The complete gun as originally designed, ran about seven feet in length.

Guard studs on the pivot of the gun are easily arranged to limit the travel within safe angles.

Small shot, of course, quickly loses velocity, and the charge drops harmlessly to earth, while the 3-inch explosive shell from the other end does the work.



Because the back end of the gun is nearly as dangerous as the front end, the pointer sits at the center. However, the recoil charge will not perforate a sheet of paper at seventy-five feet. The gun is made of vanadium steel

An Old Kitchen Sink Makes An Impressive Plumber's Sign

A NEW advertising idea is being used in Los Angeles, California. J. K. McCahan, a plumber, is attracting public attention to himself by an old, hole-worn zinc slab which he has stationed high up over a small orange tree in his front yard. The bottom of this novel shingle has been daubed over with white, and his name and his trade have been painted over this in black. No one can pass by this house without being doubly impressed by the fact that here, at least, lives a wide-awake plumber. The very holes in the zinc plate suggest the trade of the man who lives there, without the lettering. The place for the sign was decided by the fact that the little orange tree needed propping.

A hole-worn sink-top makes a suggestive advertising sign for an enterprising plumber

Gun Problems

Suddenly the gun has sprung into prominence. Here are a

Luminous front and rear rifle sights which enable a soldier to aim accurately in the dark

Fighting in the Dark with the Aid of Rifle Night-Sights

TWELVE hours do not make a working day on the fighting fronts. Even though the grist of the day's fighting has been heavy, the belligerents sometimes battle far into the night. This they are able to do with the aid of rifles fitted with night-sights, the invention of a British artilleryman.

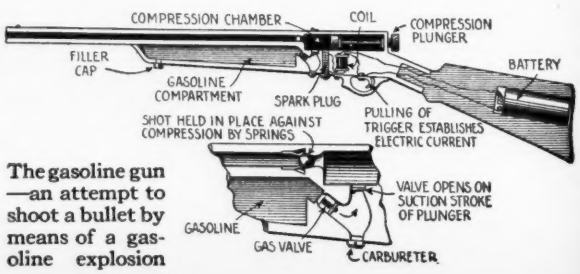
The invention consists of two spring clips which can be quickly fastened to the front and rear sights of the British infantry rifle. On the spring clips are painted strips of luminous paint which make two rough sighting points by which to direct the rifle.

The firing pin is released by pressure on a thumb-trigger

A Gasoline Gun—It's Somewhat Like an Automobile Motor

THE French used to make a little gun that threw its bullet by means of carbonic acid gas, stored in compressed form, in a reservoir carried below the barrel. When the trigger was pressed, a little valve admitted a quantity of the gas to the breech end of the barrel and blew the bullet out.

Now comes an inventor with a gasoline gun. Under the barrel is carried a reservoir of gasoline, with a carbureter behind in the frame of the arm. Batteries are supplied in the stock. The bullet is loaded into the barrel and kept from moving forward by the resistance of a pair of springs. A plunger at the back end of the breech is used to furnish compression to the gas charge delivered by a valve from the carbureter just below. Pressing the trigger closes a circuit in the battery line and ignites the gas charge, driving the bullet out through the spring resistance and through the barrel. The pressure of such a gas charge is only about one-tenth of what is necessary to drive even the little .22-caliber bullet from the ordinary rifle.



The gasoline gun—an attempt to shoot a bullet by means of a gasoline explosion

Pulling the Trigger of the Gun with the Thumb

FROM the days of the matchlock, when some ingenious gun designer arranged a little slip of steel under the grip of the gun by which the forefinger released the glowing match into the priming powder of the gun, the forefinger has been pulling the trigger of a firearm. One reason for this is that when the gun is gripped normally, the necessary spring resistance in the trigger is easiest overcome by a light increase in the grip of the upper parts of the thumb and forefinger.

A Brooklyn inventor has evolved a thumb-trigger bolt action rifle in which the firing pin is released by pressure on a thumb-trigger on the upper part of the grip, instead of by the normal form of trigger below the grip. Also he protects the thumb-trigger or plunger on the upper side of the grip by an open base peep-sight, mounted on the firing pin in a form familiar to owners of bolt types.

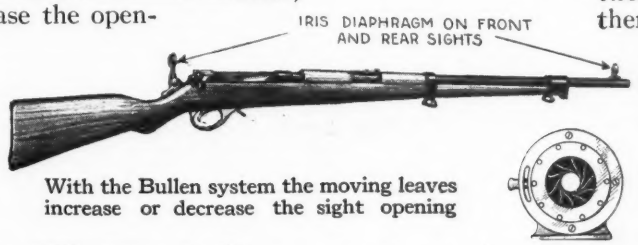
Simply Solved

few ideas which have been proposed to increase its accuracy

An Iris Diaphragm for Both Front and Rear Sights

ELIMINATING the objections both to the peep rear sight and to the aperture front sight, Brian C. Bullen, of Paterson, N. J., has done the obvious thing and applied the well-known iris diaphragm principle to both front and rear sights. Just as this form of diaphragm has supplanted in camera construction the old and clumsy form of a rotating plate with various sizes of holes, it has here taken the place of the rotating disk on the rear sight, eliminating the make-shift of changing front aperture rings to correspond with the size of the bull's-eye. The Bullen system consists merely of the familiar rotating ring controlling the leaves of an iris diaphragm actuated by a pointer or movable button. The moving leaves, as in the camera shutter, increase or decrease the opening in the sight.

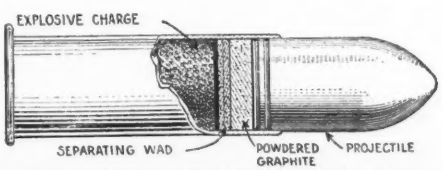
So equipped the user of the rifle can adjust the rear sight for the prevailing light.



With the Bullen system the moving leaves increase or decrease the sight opening

Lubricating the Rifle Barrel with a Graphite Cartridge

A WASHINGTON man has invented a cartridge containing a charge of powdered artificial graphite between the powder and the bullet or shell, the graphite contained between a wad over the powder, and the base of the projectile. Artificial graphite won't burn up at rifle temperatures, and it is a fine lubricant for steel. When the powder burns, the graphite is driven out between shell and chamber, lubricating the barrel both ahead of and behind the projectile, protecting the steel just ahead of the cartridge from melting by the powder gases—erosion—and lubricating the bore for the passage of the missile.



The artificial graphite is contained between the powder and the bullet or shell

WHEN CLIP IS WITHDRAWN AT AN ANGLE, SPRING RELEASES BULLET
NOTCH IN OPENING PERMITS REMOVAL OF CLIP FROM BULLETS
POSITION OF BULLET IN CLIP

Using this clip the man firing the revolver can reload the six chambers in two seconds

Reloading a Revolver in Two Instead of Fifteen Seconds

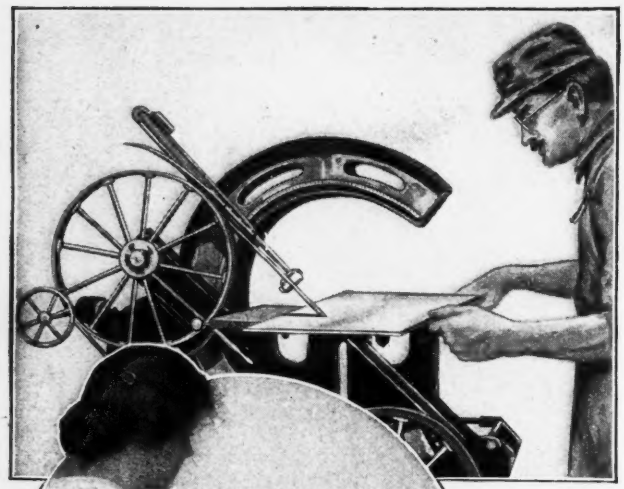
THE automatic pistol usually carries its cartridges in a detachable magazine. It is quickly reloaded by dint of slipping in a spare filled one, or else, in the case of some of the foreign war-pistols, by stripping a clip of cartridges into the fixed magazine as the soldier strips them into his Mauser. This gives a far higher continuous rate of fire for the revolver.

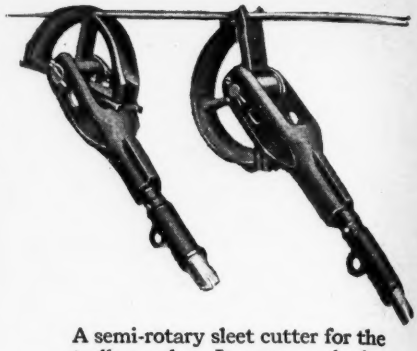
Now comes a member of one of the famous old American revolver-making firms, with a clip for slipping six shells at a time into the revolver cylinder.

He has two forms of clip, one a flat plate with holes cut around its periphery to fit the grooves in rimless cartridges, and with a circular spring to hold the cartridges in the clip or plate. In the other spring, fingers opposite each opening hold the cartridges in. Plate and six cartridges go into the gun, the cartridges into their chambers in the cylinder, the plate flat against the back of the cylinder. When fired six times, the gun is emptied by a single movement of the ejector rod as usual.

Fired cartridges can be replaced with fresh ones in two seconds.

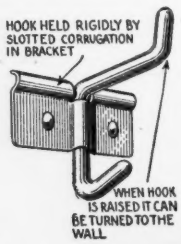
An Assortment of Mechanical Kinks Which Lessen





A semi-rotary sleet cutter for the trolley pole. It scrapes the ice and sleet off top, sides and bottom of the copper trolley wire

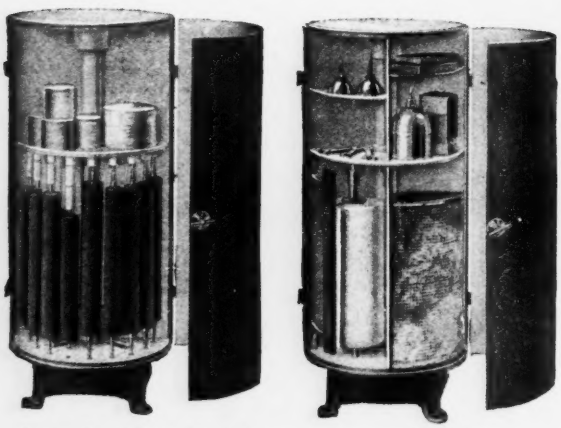
Left above: A tilting wood band-sawing machine. The saw can be moved to forty-five degrees on either side of the vertical



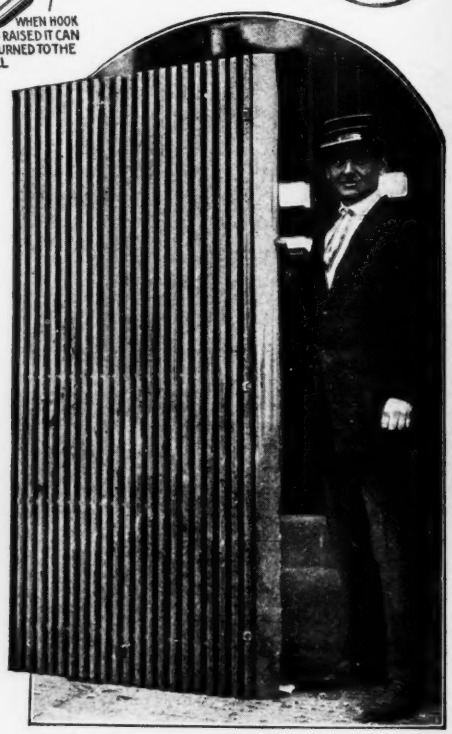
At right: A key-ring which is locked simply by pressing the outside of the ring with the thumb

Above: A combined adding machine and typewriter. A small electric motor insures maximum rapidity and minimum effort on the part of the operator

Above: A coat and hat hook which may be folded back out of the way when not in use



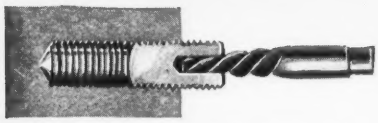
A steel cabinet for job press accessories. One side holds the press rollers and ink; the other holds gasoline, brush, wrenches, rags and pins



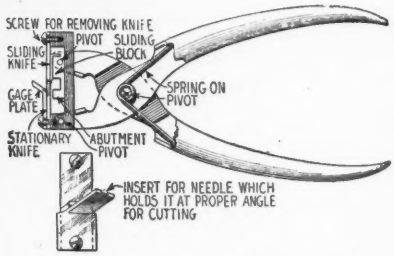
New foot-mats of wood placed in passenger stations by a railroad to take the place of coco fiber mats

Work and Take the Rough Edges Off Hard Jobs

A lawn perforator for reseeding. It is composed of a block of wood and quarter-inch spikes which protrude about three inches

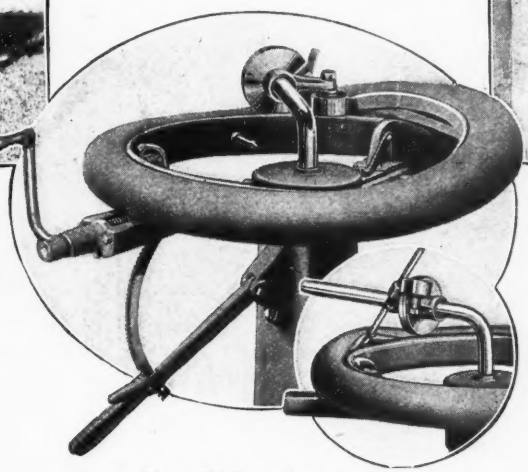


A screw extractor with left-hand spirals to grip the sides of the hole drilled in the screw that is stuck. It never fails to hold

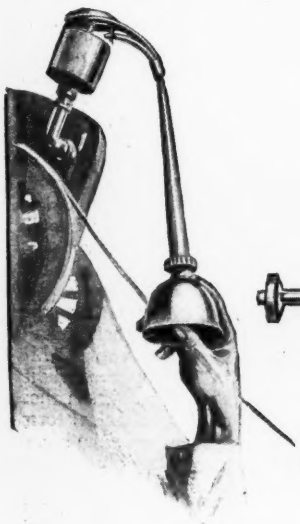


A phonograph needle cutter and sharpener, designed for bamboo needles only. The knife may be replaced after it is sharpened

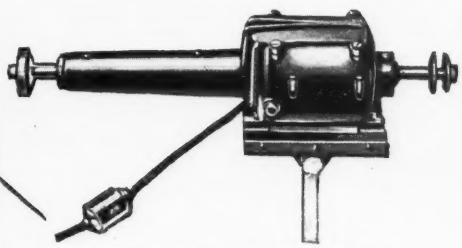
A chain-drive boring machine, for drilling holes in joists, rafters or other inconvenient places, weighs but sixteen pounds



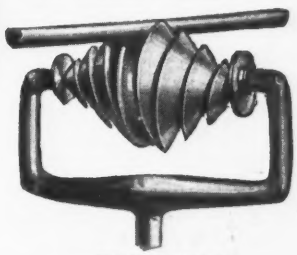
A machine which makes tire changing easy. Rollers are swung around in the reverse of the dismounting direction

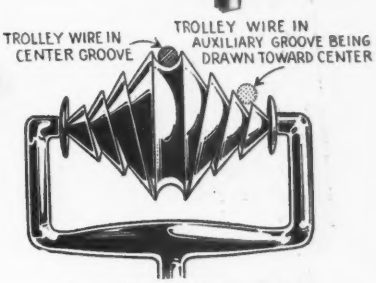


An oil can fitted with a cap-lifting prong attached to the spout. The prong can lift the strongest cap



Portable tool-post grinding machine with extension arm (at the left) for deep internal work. It grinds large gages, regrinds valves and cylinders and polishes dies





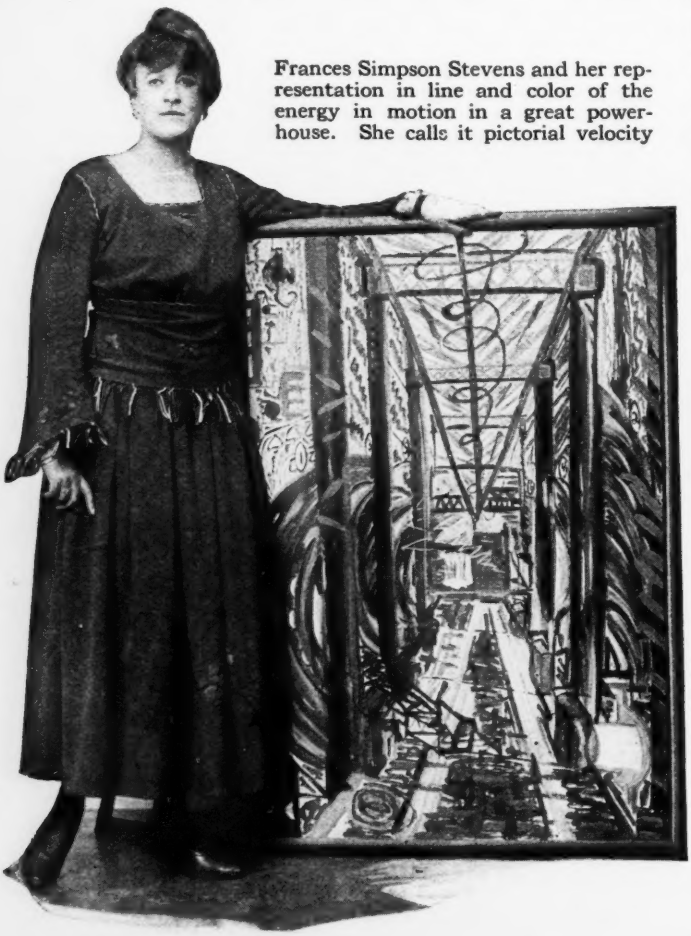
A trolley which engages the wire at all times. If the wire becomes disengaged it is automatically conveyed back to the center groove, as shown

A Power-House as a Futurist Painter Sees It

The artist sees the energy rather than the generating machinery

SUPPOSE that you were an artist and that you were asked to paint the picture of a man describing circles with a lighted cigarette held in his left hand in a perfectly dark room. How would you draw the moving cigarette? As a brilliant point of light, as a complicated curve winding in and out? Obviously, you would paint it as a labyrinth of curving glowing lines. Thus you would give the impression of motion. That being so an artist who paints a dancer with one toe on the ground and another pointing skyward is not telling the whole truth. Dancers are constantly moving, and to express their movements, something more must be done than to transfix them in a single attitude. So we find the futurists striking out in a new direction—trying hard to translate motion into color and line. You may laugh at their bewilderingly complicated effects; you may be puzzled at their efforts to explain what happens when a horse and its rider jump over a fence; but at least, they have a basic idea behind all their apparent madness.

Now the futurists have been particularly struck with the possibilities that lie in scientific and engineering subjects. One of the best known of them, Miss Frances Simpson Stevens, has boldly attacked the problem of interpreting the modern power-house on canvas. To an artist of the older schools the power-house is simply an aggregation of engines, boilers and dynamos. He knows that the shafts of the machinery spin around at the rate of hundreds of revolutions a minute; but he makes little or no attempt to give you any idea of what these terrific speeds mean. To the futurist, the machinery itself is of no pictorial importance; the let-loose spirit of the great dynamos is everything. And so we find Miss Stevens ignoring mere masses as such and actually endeavoring to paint velocity. Let Miss Stevens speak for herself:



Frances Simpson Stevens and her representation in line and color of the energy in motion in a great power-house. She calls it pictorial velocity

"Here we are, Americans, living in the biggest and most powerful city in the world, during a period of enormous inventions and stupendous activity. But there has been so far, no attempt in art to find a method adequate to express the vastness of events to-day. Machinery can be made into a harmonious, informal design. A futurist artist in Italy, seeing an ordinary street car go by, realizes the future possibilities of power and speed, and he begins to paint great trains going so fast that they lose their definite form in the lines of direction. Motion and light destroy the solidity of the material bodies. Even those artists who paint mechanical forms have achieved nothing of the life, or force, or purpose of the object. The futurists make their engines move, throb and create. Something is always happening in a futurist's pictures, and the great variety of color and changing lines helps to convey this impression."

If Beefsteak Is Too Dear, Try a Horse Porterhouse

THINK of buying all the fine meat cuts, from roundsteak to porterhouse, at from six to fifteen cents a pound! It can be done; it is being done. There are Italians, Norwegians, Germans and Swiss in New York who are paying no more than fifteen cents a pound for the choicest steaks. And they are getting meat which for palatability and nutritive value is far above most of the beef tenderloins and sirloins we consume at the prevailing price of thirty-two and thirty-six cents a pound. It is not beef that these wise foreigners are eating, but horse meat.

The very mention of horse flesh is unpleasant—not because one out of a thousand knows what it tastes like, but because we love the horse and therefore dislike to eat him. Yet the horse is perhaps our cleanest animal. He eats clean food, lives in a clean environment, and keeps himself clean. He is practically free from tuberculosis and many other serious diseases to which our flesh-producing animals are subject. Notwithstanding this, however, we continue to make beefsteak a staple food product, despite the exorbitant prices at which it is sold.

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Cutting up a quarter of horse flesh for two purchasers. The price ranges from six to fifteen cents a pound

The only horseflesh store in the country. The Department of Health supervises the slaughtering and shops

The one store in New York city, and the only one in the United States, which is selling horse flesh is doing business under the most favorable conditions. The horses are slaughtered under the supervision of veterinarians of the Department of Health and every precaution is taken to safeguard the consumer. Health inspectors are on hand to convince prospective purchasers of the food value and cleanliness of the meat. Indeed, everything is done to overcome the prejudice against it.

To prevent deceptions, no other meat may be sold under the same roof with horse meat. To sell it, a butcher must take out a special license. In France and in Germany horse meat shops have been in business for years. Outside the French shop hangs a horse's head as the trade sign.

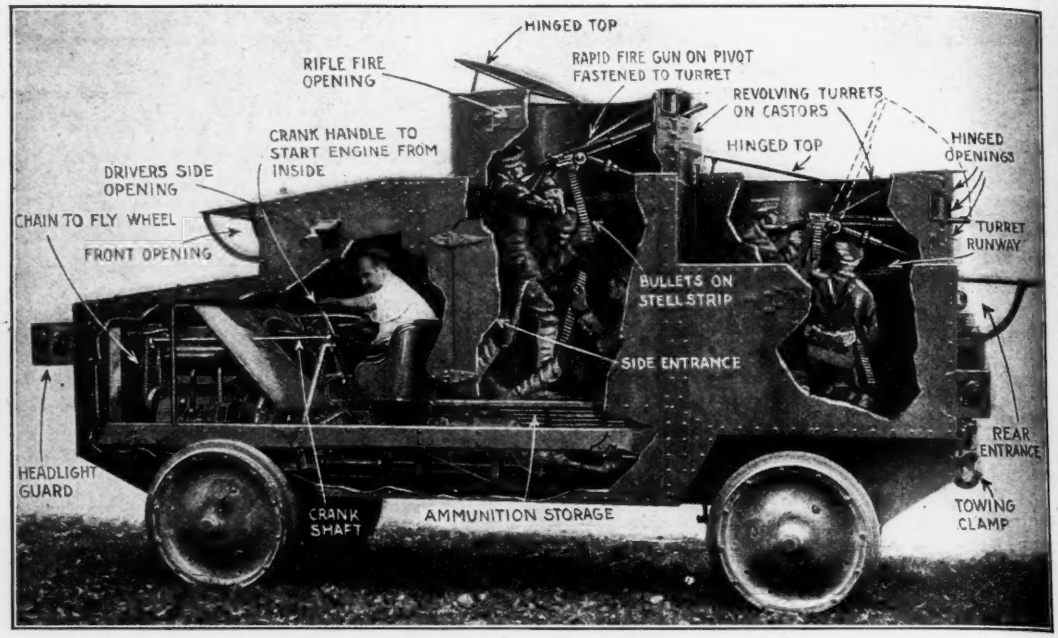
According to those who have eaten it, some knowingly and some unknowingly, horse flesh resembles beef in taste, only it is sweeter.

The Military Dentist Is No Longer a Luxury But a Necessity

Until the Canadian troops reached England with their well-equipped base hospitals and dental units, the British looked upon the military dentist as a luxury. Now the military dentist is put on a par with the veterinary surgeon. Even in Australia, where the military authorities were slowest to appreciate the value of dental hygiene, army dentists are now doing a splendid work. According to a Melbourne paper, operations numbering twenty-five thousand have been performed, and more than ten thousand teeth have been saved.

Warfare on Wheels

What the United States is doing with armored automobiles



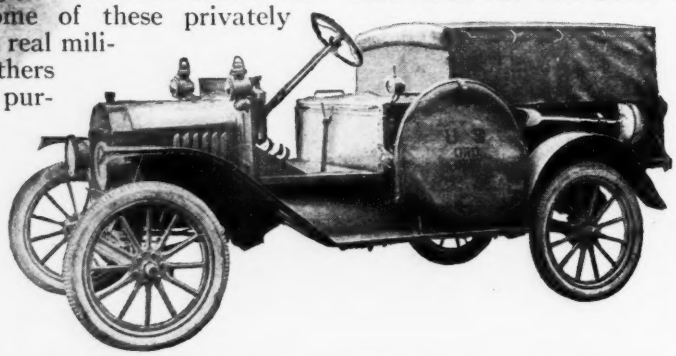
The first armored car built by the government. The chassis has a steering post at each end so that it may be run in either direction with equal facility. There are two turrets for machine guns

ARMORED motor car development in the United States has hardly passed beyond the experimental stage, as available funds have usually been needed for other purposes and the value of this weapon in the United States seemed somewhat doubtful on account of the many poor roads.

Only types actually tested or used by the War Department are shown with this article. Others have been built by patriotic citizens for National Guards organizations and by military schools and motor car companies. Some of these privately built cars are of real military value and others are for show purposes only, having ordinary steel walls instead of the treated armor plate necessary to resist bullets and lacking the equipment required for real service. These are valuable as "lesson cars."

The illustration above shows the first armored car built by the government. The chassis is a powerful machine, driving and steering on all four wheels and with a steering post at each end so that it will run in either direction with almost equal facility.

There are two turrets for machine guns, so arranged that the guns may fire through the roof upon attacking aircraft if necessary. The armor covers all vital parts and will resist a service rifle bullet at one hundred yards. The radiator door may be opened and closed and the car cranked from the interior.

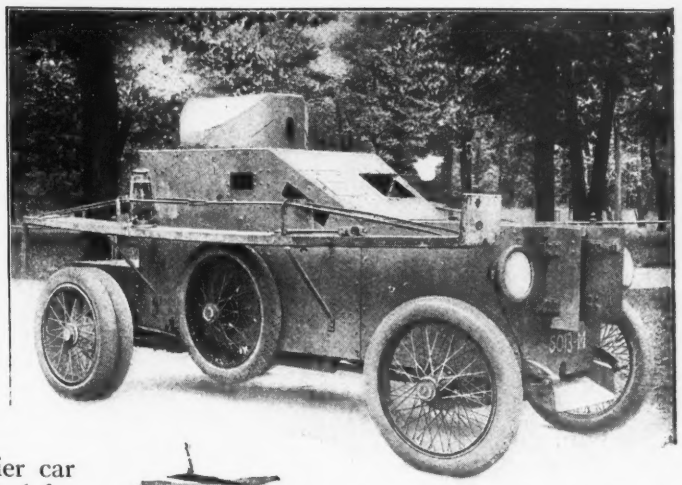


The type of light truck used by the National Guards on the Mexican border in lieu of the usual pack-mules

The weight with ammunition and supplies is about twelve thousand pounds and this weight is the principal

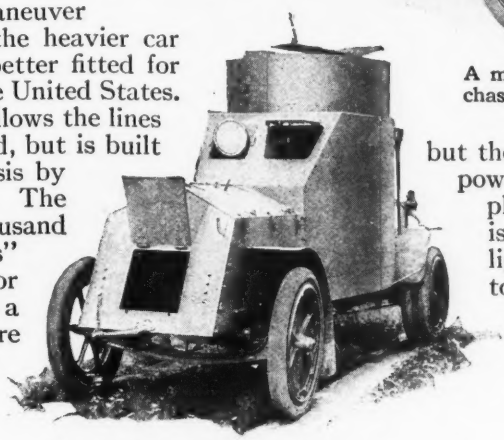
objection to the type; for on soft or muddy roads the wheels may sink so that the axles rest on the ground and the car may stall, although the great power will still turn the wheels.

Another type is a lighter car built on a rear wheel drive, one and one-half ton truck, equipped with steel wheels and airless tires and capable of running forty miles an hour. Having but one turret, the weight is reduced to about nine thousand pounds. It has not the power to maneuver on bad ground that the heavier car has, but is probably better fitted for all-round service in the United States.



A model built on a touring car chassis by a private company

Still another type follows the lines of that just mentioned, but is built on a touring car chassis by a private company. The weight is about six thousand pounds. The "bridges" carried on each side for crossing trenches form a novel feature. There are a number of other features reflecting European experience. In case of war the majority of cars would probably be of the general type of this light high-speed car.



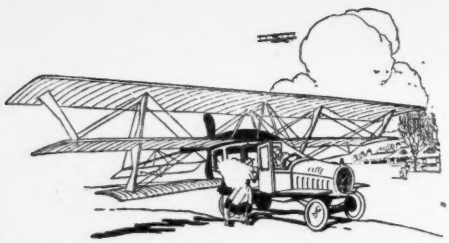
A light-weight type of high speed for general service which has received high endorsement

The light truck shown at the bottom of the preceding page is not in any sense an armored car, but is interesting as showing what was done to carry National Guards machine guns on the border. Each regiment was given five trucks in lieu of the pack mule equipment of the regulars. Four each carry one machine gun and ammunition, and the fifth, spare parts and supplies. A ten-gallon water tank is carried under each body on account of the scarcity of water which the troops encountered in the border service. In action the trucks are left under cover and the guns and ammunition carried to the firing position by hand.

The "caterpillar" type tractor is being extensively experimented with to replace horses for drawing the heavier field guns, each tractor doing the work of sixteen horses. As these tractors may come under fire, certain vital parts will be armored. More powerful tractors of this general type were doubtless the basis of the English "tanks," but the little forty-five horsepower tractor shown in the photograph on the left is only expected to do light service, principally to transport the army guns and ammunition in record time wherever they may be needed and in spite of unfavorable road conditions.

How the Submarines Got Their Peculiar Names

EVERYONE knows what submarines are, and what an important factor they have become in modern naval warfare. Their nomenclature is rather interesting. In the United States Navy the first of these crafts were named for various kinds of fish and reptiles, and we had such odd cognomens as "Adder," "Moccasin," "Pike," "Sturgeon," "Shark," "Carp," "Haddock," etc., on the naval lists. Before this list of piscatorial names ran out the system was changed, and designations of A-1, A-2, B-1, B-2, etc., down to the more recent submarines authorized in 1915, known as the O class. In general, the numbers applied correspond to the particular lot in which they were constructed, and the letters closely follow the number of years since they were first built. In Germany they are all known as U-boats, the U being the first letter of Unterseeboot, meaning submarine.



The Flying Automobile

Glen Curtiss builds a limousine in which you can take trips through the air

By Carl Dienstbach

SEVERAL years ago Glen H. Curtiss launched into the air a new kind of craft, which he called a "flying boat." Such a craft is much heavier than a land aeroplane. Naturally, Curtiss asked himself: If a heavy motor-boat can fly, why should it not be possible to launch a heavy automobile into the air by means of wings.

Although Curtiss was the first to make a flying boat, he was not the first to conceive or even carry out the idea of flying in an automobile. About six years ago the French oil magnate, Henri Deutsch de la Meurthe actually placed an order with the Blériot works for what he called an aero-taxicab. That name fitted it well. It looked like one as it flew in the air.

© Amer. Press Assoc.

The lines of the automobile have been deliberately retained in spite of the tremendous downward pressure of windshield and motor hood

It used to be supposed that triplanes would never do for fast flying because of the great head resistance which they offer. But resistance can be reduced by proper designing, and triplanes, as a result, are as fast as the biplanes of three or four years ago. A triplane can be made strong and still light. That, no doubt, is the reason why Curtiss adopted it when he made up his mind to build a flying limousine.

Look at Curtiss' new machine, as it is revealed in the accompanying picture. What a contrast there must be between flying in this well-designed enclosed body and an open military machine! You step in, wearing your silk hat and afternoon clothes, just as you would into an automobile which is to take you to some fashionable tea. The body of the Curtiss limousine is remarkably well designed, from an aeroplane point of view. At the rear, the car body terminates in a knife edge. This also made it necessary to place the propeller behind the limousine, in the same manner as a slender poop is provided for the protection of a steamer's screws. It may be noted that the aeroplane portion of the craft is very much like the triplane built by Curtiss recently for Ruth Law and described in the March issue of the POPULAR SCIENCE MONTHLY.

The use of an automobile body has solved at one stroke a knotty mechanical problem. In the ordinary flying machine, motors and propellers are directly connected. In the flying automobile, there is a reduction gear between the motor and propeller—something quite new. This appears in the form of a shaft running back through the limousine and connected by belts and pulleys with the propeller shafts. Thus, it becomes possible to drive a 9½-foot, four-bladed propeller—extraordinarily large—by only a hundred-horsepower motor. Obviously, by slightly raising the limousine's floor, a change-gear and a reversing gear might have been installed as snugly as in an automobile. This would have made it possible to start and land on restricted areas.

The front wheels of the machine are steered exactly as they are in an automobile, so that the craft can run on unobstructed land for long distances.

Can We Protect Our Coasts?

On the Atlantic seaboard a hostile army of 400,000 could land at 116 undefended points

WE have, approximately, five thousand miles of coast line, about three hundred miles of which are now protected by twenty-nine coast defenses. Military men regard the navy as the first line of defense, coast defenses as the second line, and the army as the third.

But no matter how strong a coast defense may be, if it cannot repel land attack as well as sea attack it is practically useless. Thus big guns are not alone sufficient; there must be a land force and small arms. The latest official estimate places the number of our coast artillery at 508 officers and 19,278 men. Obviously, this is far less than it should be. Furthermore, our guns are for the most part old models, hopelessly outdistanced by the powerful fifteen-inch guns of such ships as the Queen Elizabeth. So, when General Wood says that an enemy fleet could lie off Far Rockaway and throw shells into Fourteenth Street, New York, we have to swallow hard and admit he's right. However, his statement is short-lived. The Government is now building a fortification at Far Rockaway, which, it is hoped, will protect New York from danger. But as regards Chesapeake Bay, one of our vulnerable points, nothing has been done to protect it from the danger of foreign invasion beyond the placing of submarine nets.

The stars indicate the positions of forts along the Atlantic Coast. There are no less than 116 undefended points

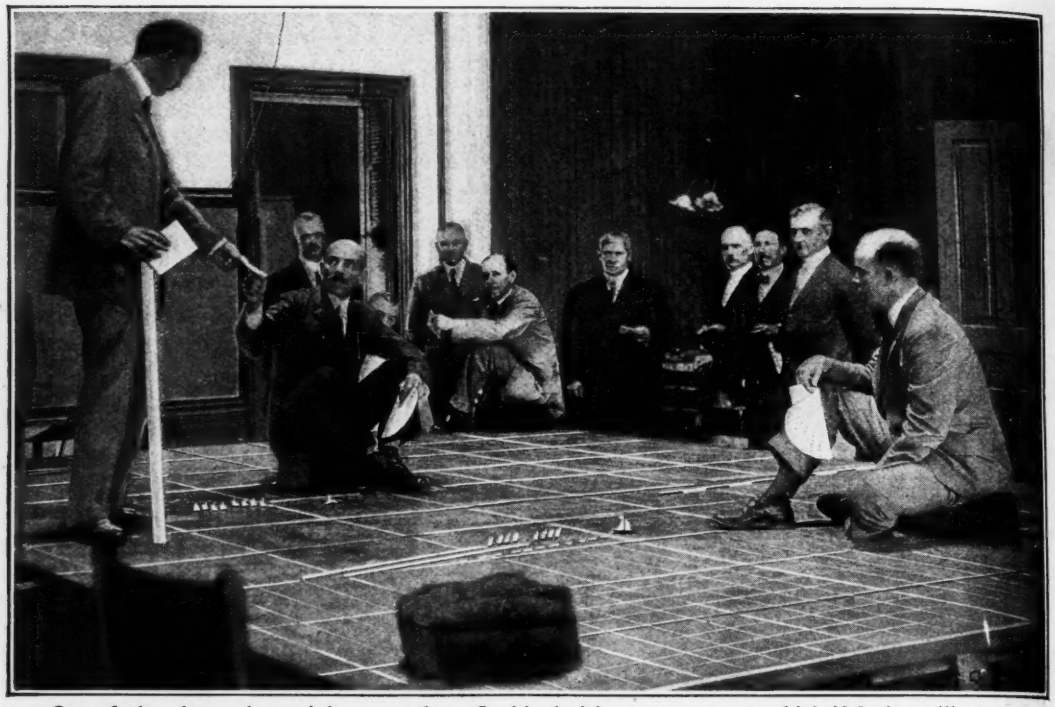
So small was the supply of coast defense ammunition in 1915 that it would be exhausted in forty-five minutes by a capacity fire of our coast defense guns. If the firing were done by howitzers, the ammunition would last about thirty minutes. Fortunately, this situation is no longer true, due to a reawakening of the authorities at Washington to the real state of affairs. Our ammunition supply has steadily increased since 1915. But it must still be far behind the needs of the hour.

Our own army officers have pointed out to us that 400,000 men could easily be landed on the Atlantic Coast. A system of heavy guns permanently mounted on railway carriages—mobile forts, in other words—has been suggested as a means of protecting our coast area and inland cities. They might prove useful, when it is considered that there are no less than one hundred and sixteen undefended points where an enemy could place troops. These statements are alarming. About the only redeeming feature of our situation is to be found in our railroads. We have a valuable net of railroads which could transport troops quickly.

In spite of the despairing predictions made by our military authorities, one of which is that it will be years before our coast defenses and mobile army can be developed into real fighting units, there is the hope that some agency—motor torpedo boats, coast submarines, mobile forts, or whatnot—may back up our coast fortifications and afford our coast line the protection it needs.

How Our Naval Officers Play at Battle

In the naval war game all the world's at war and all the men merely officers and fighters



One of the players is receiving an order. On his decision rests a move which if faulty will score heavily against his side. The table on which the game is played represents the sea

THE game-board on which our naval officers fight out imaginary naval battles based on a problem with which they would be confronted in real war is a low table which represents a section of the sea. It is divided into small squares. The pawns in the game are small leaden vessels that represent in outline the different classes of warships. When the problem is first assigned, the players, who are usually experts at the Navy War College, Newport, R. I., are divided into two sides. Each has its Commander-in-Chief, who is assisted by a staff just as he would be in war. The game begins on a chart. When the scouts report "Contact with the enemy" the problem is transferred to the game-board, on which the supposed engagement is fought out to its smallest detail. Fuel supply, casualties, wind and weather figure in this theoretical battle.

The ships are moved on written orders which may be either radio or flag signals. In the illustration one of the players is receiving an order, and on his decision rests a move, which, if faulty, will score heavily against his side. The track of each ship, as it moves across the squares, is marked by chalk to show its position at any time of the twenty-four-hour fight staged on the board. The tracks help in working out the torpedo runs so that effect of torpedo fire may be plotted.

When the fleets come in effective range, say at 14,000 yards, fire is opened. The effect of the fire is marked by a card system on the blackboard in rear of the players. Actual war conditions are thus simulated. A ship damaged fifty per cent, for instance, is marked down in loss of speed and maneuvering ability.

The importance of approach to battle is driven home; for a slight initial error may turn out to be the pivotal point in the fight. The game-board trains officers to make quick and accurate surveys. Delays in making the right move spell disaster. Maneuvering for the best position to be ready when fire action opens is another point on which stress is laid. Every detail

of the great Jutland Battle has been fought out on this game-board.

On the board the home fleet is shown by light-colored ships, and the enemy's by dark-colored ones. When the game begins on the board the scouts are shown in contact. Behind their screen the supporting ships close up, and behind them the big battleships maneuver for the opening of fire action.

The war game as practiced now by all armies and navies was first devised by Von Moltke, who, when elevated to the post of Chief of Staff in 1857, introduced it into the German army. The United States army works out its problems on maps scaled twelve inches to the mile, at the Leavenworth Army School of the Line. The Coast Artillery has its own game, in which the advance of a hostile fleet is opposed by mines and gun fire. The artillerists are taught to identify at a glance every type of foreign vessel.

Stopping the Automobile with a Vacuum Brake

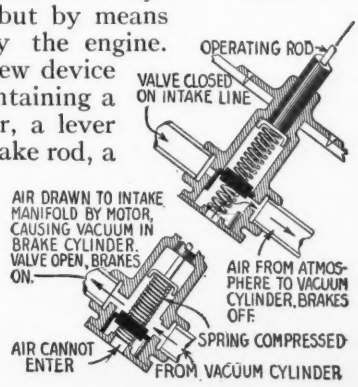
A NEW brake has been invented for automobiles—a vacuum brake, which, as its name implies, operates not by the force of compressed air but by means of a vacuum created by the engine. The mechanism of the new device consists of a cylinder containing a piston faced with leather, a lever that connects with the brake rod, a small controlling valve and sufficient copper tubing to connect the intake manifold with the valve and the vacuum cylinder.

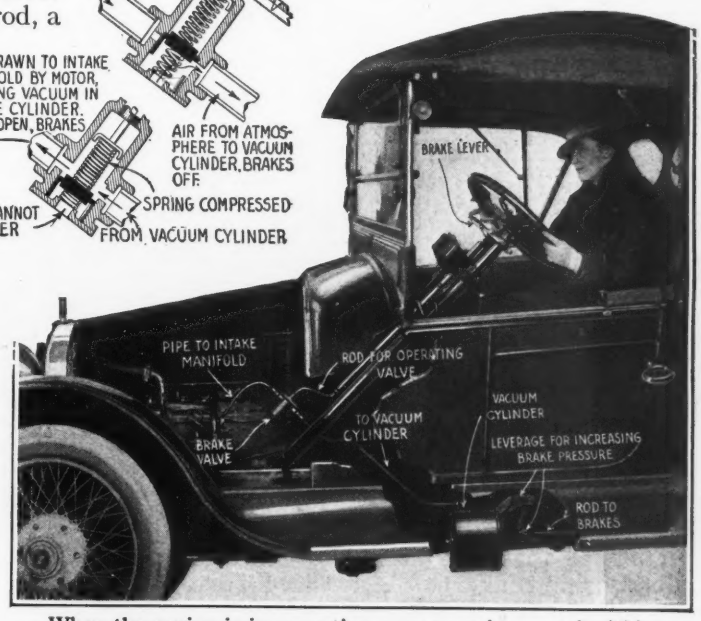
When the engine is in operation a vacuum is created within the intake manifold which amounts to a suction of about ten pounds to the square inch. This suction is employed to move forward the piston in the cylinder. By leverage this suction pull may be developed to a thousand pounds pressure at the rear wheels. The pressure of a finger on a lever at the steering post is sufficient to apply this tremendous force to the brakes.

The vacuum brake with its thousand pounds pressure serves to counteract any inequality of brake adjustment. Thus if one brake requires three hundred pounds pressure to make it effective, while the other responds to not less than five hundred pounds pressure, it will be evident that one thousand pounds applied between them will be ample for both. This makes brake operation more certain and is an important safety factor.

The engine must be running in order to make the vacuum brake operative, but the very slowest movement of the motor is sufficient to get results. Even with the gear lever in neutral and the engine at rest, the application of the electric starter is sufficient, or the cranking of the engine by hand will accomplish the same result. A slight leak in the copper tubing will not interfere with the action of the vacuum brake.

While acting as a service brake, this new "self-starter" is not designed to replace the hand or emergency brake which holds the car on a grade while the engine is idle. The cylinder is only four inches long and has a diameter of seven and three-eighths inches. It is braced in position by attaching it to cross members of the frame. The controlling valve may be attached to the lower part of the dash or the engine base.


OPERATING ROD
VALVE CLOSED ON INTAKE LINE
AIR DRAWN TO INTAKE MANIFOLD BY MOTOR, CAUSING VACUUM IN BRAKE CYLINDER. VALVE OPEN, BRAKES ON.
AIR FROM ATMOSPHERE TO VACUUM CYLINDER, BRAKES OFF.
AIR CANNOT ENTER
SPRING COMPRESSED FROM VACUUM CYLINDER



When the engine is in operation a vacuum is created within the intake manifold which amounts to a suction pull of ten pounds to the square inch. This is magnified by leverage

The Terror of the Sea

How submarines are driven and submerged; the difficulty of building them very big; the folly of the one-man submarine

A SUBMARINE is a maze of machinery. Unlike any other ship she has two sets of driving engines—one oil and the other electric—and she is built with the nicest regard for weight.

First let us say something about the engines. They are the most important part of the boat.

At first gasoline engines, like those used on automobiles and motor-boats, were installed in submarines. The Germans had them in some of the submarines that they used in the beginning of the war. We, too, used them. But as the gasoline engine was made bigger to meet the demand for increased power and speed it literally broke down. The Diesel engine must be used. It was invented by Rudolf Diesel, a German engineer, while he was still a student.

In the Diesel engine air is sucked into the cylinder and subjected to such pressure by the piston that it becomes intensely hot. Then a little oil is squirted in. At once the oil-vapor ignites and the mixture of oil-vapor and highly compressed air expands with explosive suddenness. The Diesel is the most efficient type of engine ever invented, utilizing as it does about thirty per cent of the energy in the fuel as contrasted with only thirteen per cent in the best steam-engines. But it also uses air. In other words it breathes. When a submarine is under water the crew must keep alive by breathing what air they can obtain from tanks. They have enough for not more than thirty-six hours.

So, it becomes necessary to equip a submarine with electric motors, fed by storage batteries. As soon as a submarine dives, the breathing Diesel engine is cut out and the electric motor switched in.

Down in a Submarine

Like the policeman's in Gilbert's song, the life of a submarine sailorman is not a happy one. The quarters are necessarily so cramped that it is difficult to provide ordinary ship comforts. The officers have cots and the crew hammocks for sleeping. In our new boats ice-boxes are provided, so that fresh meat and vegetables can be served. In addition there is a dry food supply sufficient for five days. At sea the crew is put on a daily fresh water allowance. To bathe, the men must jump over the side.

Even when the boat is running on the surface the ventilation is poor. The proprietor of a New York sweatshop who did not provide his workmen with any more air than the men in a submarine breathe would be arrested. When the boat is submerged, the nauseating oil odor, the battery fumes, the vitiated air exhaled from a score of lungs make one wonder why everyone is not sick. As a matter of fact seasickness, produced by these conditions, is common enough.

What is the scene within a submarine when an attack is made? A German officer of the U-26 gave this account of an attack on an unnamed British warship:

"The boat is cleared for action. The flagpole is taken down. Part of the bridge is folded up and lashed. The periscope is elevated. The hatch through the combined bridge and conning tower is tightly closed. The motors cease their endless song. From now on electricity will drive us until we rise to the surface again.

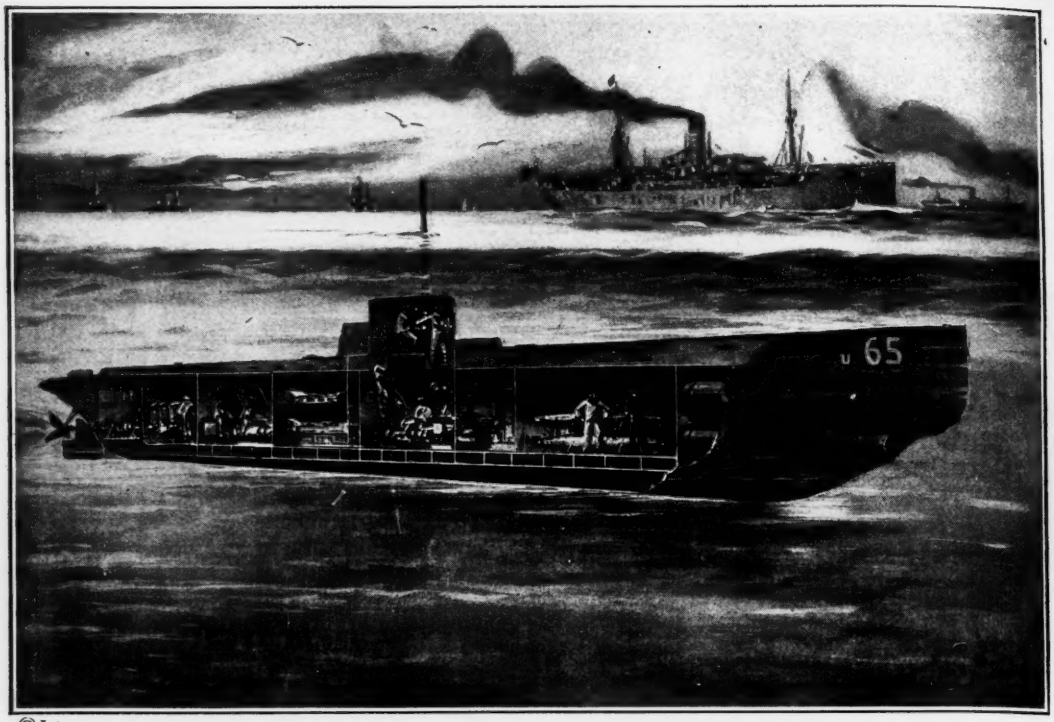
"A young lieutenant is posted at the periscope and looks for the enemy. The sailors take their position near the torpedoes. The interior of the boat is lighted with two small electric bulbs. They do not clear the gloom. Everywhere is the smell of stale oil. It is impossible to speak with the din of the machinery and of the inrushing water.

"From time to time the officer in command of the torpedoes looks at his watch, which he wears on his wrist, or at his compass. Intently the men all watch a signal board in front of them on the side of the boat. . . . Suddenly we start and forget the heat, the foul air, the discomfort. In small luminous letters the word 'Attention' flashes up on the board. The commanding officer grasps the lever which will release the first torpedo. The men prepare to launch the second as soon as the first is discharged. Half a second later and the red letters on the board say 'Fire!' The lever is jerked, and the torpedo leaps out. There is a short metallic click and the noise of the water rushing into the empty tube. The second torpedo is at once inserted. A few seconds later and the interior of the submarine looks as before the attack began.

"But what of the first torpedo? We hear only the noise of the motors. We wait. Nothing happens. Then suddenly we are all thrown in a heap by the shaking of the boat. Then the boat rolls as before. The regular purring of the motors is heard. We are on our way home. The attack succeeded."

The Mine-Layer Lays Mines As If They Were Eggs

The German mine-layer is a new and ingenious type. It carries no guns or torpedoes—nothing but mines confined in twos in inclined tubes at the bow. The mine itself (insert) has a sinker which carries it down to the bottom, where hinged legs are forced out and lie flat on the ocean bed. By means of a hydrostatic valve the mine is enabled to remain at the right dead level



© Int.

Every member of the crew knows exactly what he must do; not only that, but he knows, as a rule, the duties of every other man. This means team work

As this vivid description indicates, a submarine is submerged by letting sea water flow into tanks.

A submarine has two kinds of tanks—one for ballast, the other for trimming. The trimming tanks, used to trim the boat fore and aft, are in the bow and the stern; the ballast tanks at the bottom and sides. The torpedo tubes are usually in the bow of the boat, although there may also be tubes in the stern and even in the side as in some foreign boats. Let Lieutenant C. N. Hinkamp of our Navy tell us how the boat is handled:

"The actual submerging of the boat can be done in two ways, one called the 'static' dive; the other the 'running dive.' In the static dive, also known as 'balancing,' the boat is submerged, but does not move except in the vertical plane. This dive can be accomplished in two ways; by trimming the boat and maintaining her trim by adjusting the ballast, or by dropping the anchor, trimming the boat to within a few hundred pounds positive buoyancy, and then heaving in or veering on the anchor cable.

"The mass of a submarine itself amounts to several hundred tons, but the actual forces used to sink it from a neutral state are very small. The addition of 50 pounds of water will cause the boat slowly to descend. . . .

"The static dive by adjustment of ballast is made as follows: After getting the fore and aft trim. . . . the main ballast tanks are flooded through large valves, the operation requiring from one to two minutes. . . . The boat being trimmed down as far as the main deck, still has too much buoyancy to run submerged. The tank next flooded is the auxiliary ballast tank. This holds enough water to destroy the remaining buoyancy. . . . The final trimming is done by slowly filling the adjusting tank. When the vessel is trimmed until there is about two or three hundred pounds of positive buoyancy, it can be readily handled submerged. This is considered the best trim for all around work and completes the static dive. From this condition any operation submerged can be commenced. To be able to determine when to stop is almost the entire secret of the art of balancing.

"The running dive is made from the awash condition. In the awash condition the trimming tanks and auxiliary ballast tanks are flooded to the amount necessary for the proper trim when submerged; the main ballast tanks are empty. The vessel being underway 'awash,' the order is given to submerge. All hands get into the boat, the engines are stopped and the electric motors are started. As soon as the engines are stopped the conning tower is closed, all ventilators are housed, and the main ballast tank is flooded. . . . The boat is inclined slightly, about one half a degree down by the head, and the inrush of the water controlled by manipulation of the valves. All this is done in the short period of from one to two minutes."

A submarine may run submerged with only her periscope sticking out above the water. Then she can see all about her

plainly enough. When even the periscope will betray her, which it does partly on account of its wake, she must dive completely and become absolutely blind. Hence, the periscope has been fittingly called the "eye" of the submarine. It is a telescope built so that you can see around a corner or over a wall of earth or

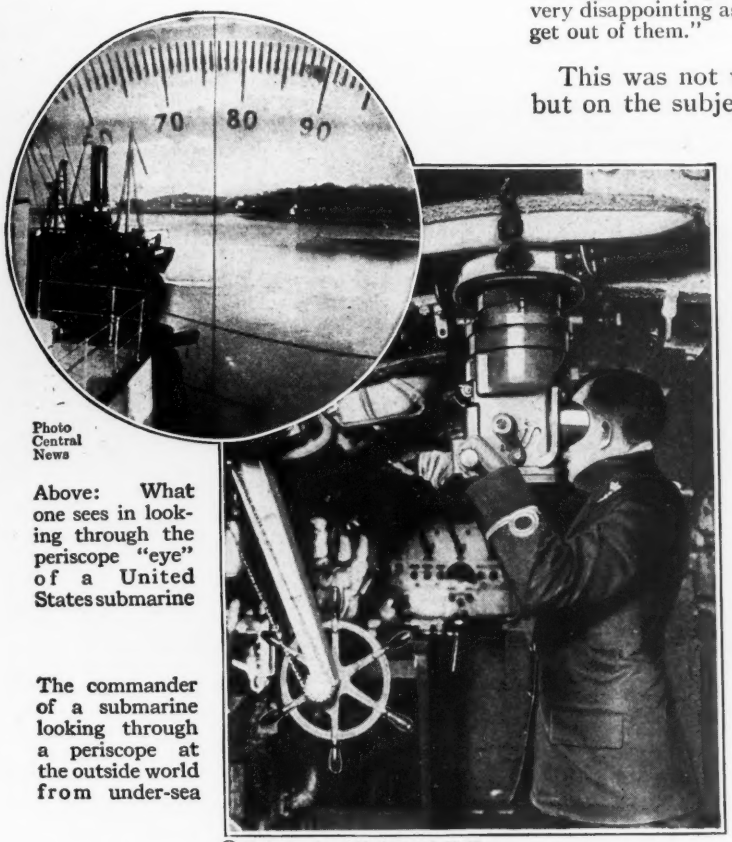


Photo Central News

Above: What one sees in looking through the periscope "eye" of a United States submarine

The commander of a submarine looking through a periscope at the outside world from under-sea

© Underwood and Underwood, N. Y.

water. There are as many kinds of periscopes, almost, as there are styles in hats. Each boat in all navies carries at least two periscopes, one for the commanding officer and one for the helmsman or second officer.

The One-Man Submarine

Henry Ford's proposal to build cheap one-man submarines has once more focused attention on an idea that has always fascinated inventors. But no one who is at all familiar with submarines believes in the one-man type. In a letter to the POPULAR SCIENCE MONTHLY, Simon Lake, our foremost submarine inventor, disposes of the question in this fashion:

"A number of one-man submarines have been built, but they have never proven to be of much value because they had such a short radius of action and low speed. The modern Whitehead torpedo is something over 18 feet in length and 18 inches in diameter, and it requires a good sized vessel to carry one of these within the hull. If carried outside the hull, which has been done in some cases, the torpedo offers much additional resistance to a small craft and thus tends further to reduce its speed.

"We prepared a number of one-man boats, which our engineers designate 'pickle-boats,' but they were very disappointing as to the speed it was possible to get out of them."

This was not written of the Ford plan, but on the subject in general.

Ford's idea of building one-man boats very cheaply is ridiculed by naval men. The engine necessary to obtain high speed would have to be as light as an aeroplane motor, and aeroplane motors cost about $5,000 each.

Thomas Orchard Lisle, a prominent marine engineer, punctures the Ford idea very effectively when he points out what are its limitations:

"Mr. Ford proposes to drive this submarine with the same engine that is used in his automobiles, of which, I believe the maximum horsepower is forty under the best conditions. This would give a small boat, say twenty feet long, a submerged speed of not more than eight knots; that is if an internal combustion engine could run when the boat is submerged. So imagine the futility of chasing a thirty-knot battle cruiser with an eight-knot submarine."

Mr. Ford has not considered among other things, the difficulty of supplying air to the engine and to the solitary constituent of the crew, nor the disposal of the exhaust gases, so that they may not betray the boat in a soda-water wake, nor the utter impossibility of operating such a boat in a rough sea.

In their mine-layers the Germans have developed a new and ingenious type of submarine. One of the mine-layers was captured by the British last year, and the details of her construction have been given out by her captors. She is about 110 feet long, and 11 feet beam, and she displaces

Held Up By a Submarine

© Int Submarine warfare as conceived by Willy Stöwer, the celebrated German artist. The submarine has stopped an English ship and orders have been signaled to her captain to man his lifeboats and save his passengers and crew before the deadly torpedo is discharged. The submarine sailor, rope in hand, evidently expects to throw it to the lifeboats, to tow them toward land or toward a steamship lane where they will be picked up

about 200 tons. In other words she is not more than one third as big as an ordinary sea-going, commerce-destroying German submarine.

A mine-layer carries no guns or torpedoes —nothing but mines confined in twos in inclined tubes at the bow. The mines are released from the conning-tower. Each mine has a sinker which carries it swiftly down away from the submarine. As the mine sinks, hinged legs are forced out by springs, the legs lying flat on the bottom of the sea. The mine itself is attached to the sinker or anchor by means of a chain. Soon after the sinker strikes the bottom the mine floats up. A device called a hydrostatic valve regulates the height of the mine above the anchor, so that whether it be high or low tide the mine will always be at the right dead level.

Although Britannia still rules the waves quite as completely as she did in the days of Drake and Nelson, the submarine has unquestionably made her more cautious. The English Grand Fleet emerges only when it has a prospect of fighting, and then only when it is preceded by a cordon of torpedo boat destroyers, which keep an eye out for German submarines, and a squadron of mine-sweepers and trawlers which fish out mines planted by submarine mine layers and which net any submerged submarine in the course. When the battle fleet is safely out in the open sea it must keep moving. The blockading squadron, too, must not venture too close to German shores, and it, too, must move always.

Naval officers are by no means agreed what type of submarine the United States should adopt. While some pin their faith to the big, German sea-going type and others boldly advocate the fleet submarine, even though no one knows how to obtain the engines to drive it, others recommend a comparatively small coast-defence type.

In view of our present conflict with Germany, every American wonders what we would do if the British fleet were not engaged in corking up their German dreadnoughts? Considering our two enormous coast lines, our possessions in Alaska, the Philippines and the Hawaiian Islands, some of our officers think that we need not only coast defence submarines (the 800-ton type with a surface speed of 17 knots, able to remain at sea for three weeks) but something much more formidable. Thus, Captain W. L. Rogers agrees that if our main fleet is destroyed, coast defence submarines cannot prevent an enemy from landing, because they cannot know when and where an attack will be made, and they cannot escape drags and nets forever. What we need, according to him, are fleet submarines—vessels which will be able to keep at sea with scouts and battleships, which will have a surface speed of at least twenty-five knots.

© Int. An aeroplane can detect a submarine under water. It is, therefore, one of the most formidable of enemies

This problem of building a submarine which is able to keep pace with a fleet of battleships and battle cruisers, is so difficult of solution that some naval authorities despair of seeing it solved at all. At present no submarine, even of 1200 or 1500 tons, can be equipped with sufficiently powerful machinery to make the required twenty-five knots necessary to keep up with a battle-ship squadron. On the other hand, small submarines cannot act for months at a time with the main fleet perhaps a thousand miles from a base. They have neither the speed nor the endurance.

been signaled to her captain to man his lifeboats and save his passengers and crew before the deadly torpedo is discharged. The ... rope in hand, evidently expects to throw it to the lifeboats, to tow them toward land or toward a steamship lane where they will be picked up

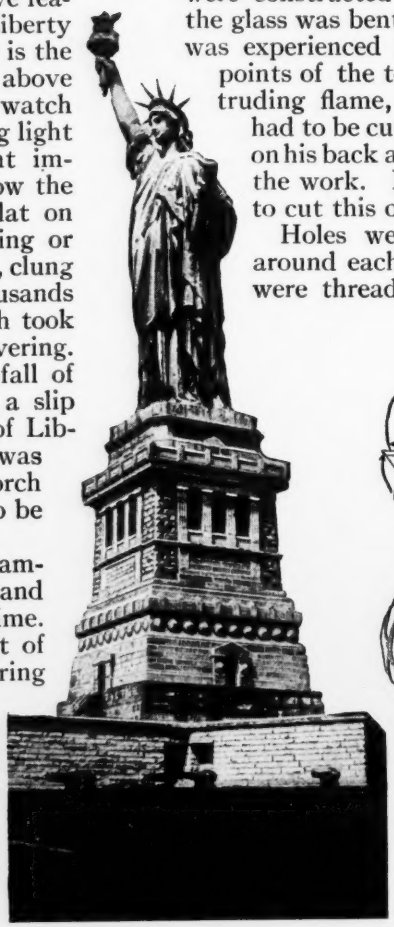
Liberty's Improved Torch

Three tones of tinted glass were substituted for six hundred square feet of bronze

To cut out pieces of the bronze plating in this long protruding flame, one man lay flat on his back upheld by a fellow workman. It was a six days' job

ONE of the most impressive features of the Statue of Liberty as it illumines the night is the flaming torch uplifted high above New York harbor. Few who watch the torch's symbolic flickering light know the story of its recent improvement—know, indeed, how the workmen, oftentimes lying flat on their backs with no scaffolding or underpinning to support them, clung to the framing and drilled thousands of holes for glass plates which took the place of the old bronze covering. A false movement meant a fall of more than twenty feet and a slip and slide down the interior of Liberty's arm. Besides there was the constant swaying of the torch and arm during high winds to be reckoned with.

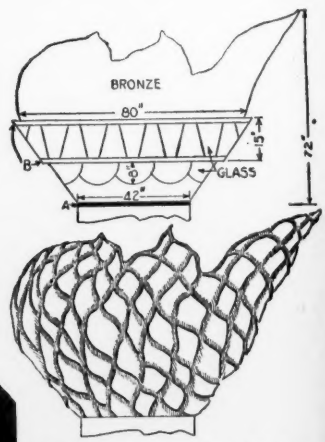
But these dangers did not dampen the ardor of the glazers and they finished their work on time. To-day Liberty's torch is not of dull bronze but of shimmering glass, as Bartholdi, in the judgment of Gutzon Borglum, the sculptor, wished it to be. Situated three hundred and fifty feet from the upper terrace, the torch is reached only by a sixty-foot ladder which starts from a small platform at the shoulder and runs up the arm to Liberty's hand. At this point a six-foot vertical ladder leads to a two-foot gallery running around the base of the flame.



The first work was the removing of the crude steelwork and the substitution of sheet bronze, as described in the POPULAR SCIENCE MONTHLY for February. Following this, yellow glasses of various tones were selected and graduated from the bottom up in deepening shades. On windy days the torch twists and shakes. Hence the ordinary method of glazing could not be employed. A new method had to be devised—and without delay.

Pieces of the bronze plating were cut out from the inside of the torch, and molds were constructed from them upon which the glass was bent. The greatest difficulty was experienced in reaching the extreme points of the torch. The one long protruding flame, which is shown above, had to be cut open by a man lying flat on his back and held by another during the work. It took two men six days to cut this one section.

Holes were punched in the ribs around each opening and brass bolts were threaded through them. Over the bolt ends was placed a small clip spring. The glass was given an edging of non-hardening putty; another clip spring was slipped over the bolt end, and the nut was

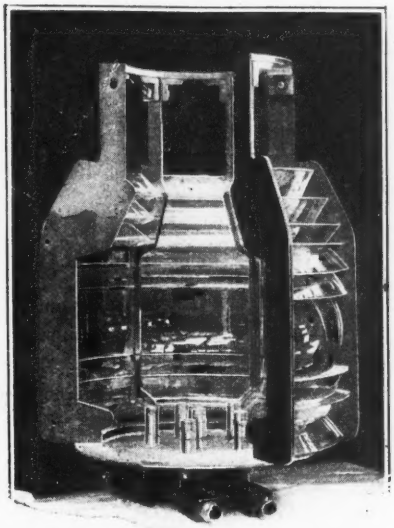


The glass is embedded in soft putty and kept rigidly taut by spring tension

Miss Liberty's torch is no longer of dull, inert bronze but of shimmering glass

screwed home. Bedded thus in soft putty and kept taut by the spring tension, it is impossible for the glass to break, even under the severest strain imposed by snow, ice, rain, or heat.

Inside the torch are fifteen five-hundred candlepower incandescent lamps connected with a flasher (a flasher is a rotating drum with surface projections which close the lamp circuits every time they hit a stationary piece of metal) to carry out the unsteady flicker and blaze of the burning torch. The torch also contains a lighthouse lens, nine and one half inches in diameter and fifteen inches deep.



There are fifteen of these five-hundred candlepower lamps inside the torch of the Statue

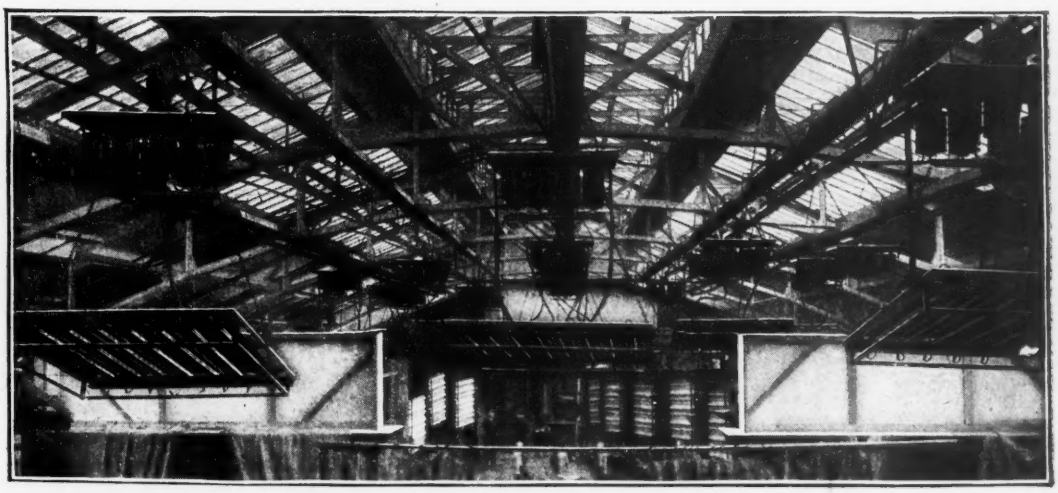
Super-Daylight for the Motion-Picture Man

ONLY those who have visited a motion-picture studio and have watched the actors rehearsing under a battery of mercury-arcs, can realize the important relation of light to the successful photographing of an indoor stage scene, or, as the motion-picture folk call it, a "set." There is not only lavish, blinding light, but sweltering heat; for the lamps are veritable furnaces.

In one of the New York motion-picture studios, which is situated on the top of a glass-covered fireproof building, a gigantic overhead lighting system costing fifty thousand dollars was recently installed. The system comprises twenty-five overhead units of mercury-arcs. These units run on five tracks, with eleven contact spaces to each track, indicated by white paint. By shifting a unit a few inches either way light is obtained for the deepest sets.

The steel tracks supporting the overhead lights are nine feet apart and one hundred and seventy feet long. In addition to this overhead system the general lighting equipment of the studio is supplemented by another battery of floor lights. When all the lights are going at one time, "super-daylight," according to the enthusiastic and imaginative director, is obtained.

When a play is being rehearsed an automatic switch enables the director to turn off the big batteries and substitute in their place incandescent bulbs. In the studio in which this vast lighting equipment is employed five directors can photograph as many sets at the same time. The stage is seventy feet wide and one hundred and seventy feet long.

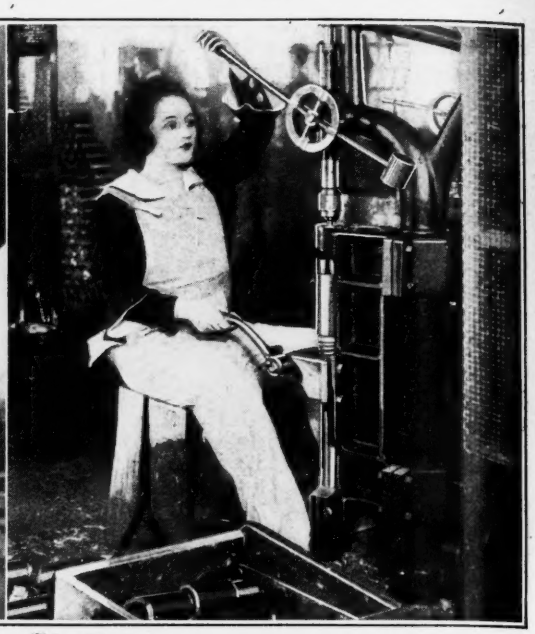


Close-up view of the portable contact and carrying device. Contact spaces in the trolley feeders are indicated by white paint. There are twenty-five overhead units of mercury-arcs which run on five tracks, with eleven contact spaces allotted to each track

New York State Protects Her Strategic Points and

© Amer. Press Assoc.

One of the New York Naval Militia boys guarding the entrance to Williamsburg bridge. The entire Militia was called out as well as the National Guard and ten thousand policemen



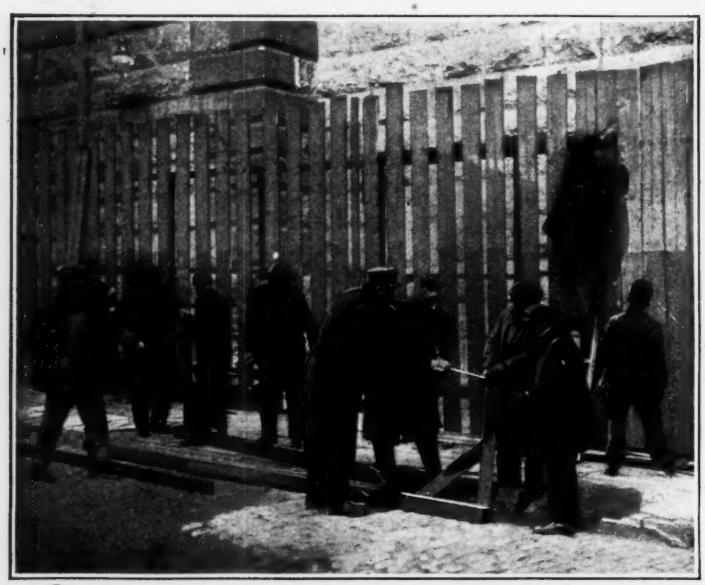
© Int. Film Serv.

An American girl turns out shrapnel in a New York plant. She and twenty other young girls volunteered their services

© Int. Film Serv.

The first day's duty. Bridges and public buildings have to be guarded in the face of a blinding snowstorm

Below: Building a fence around an arsenal to protect it in the event of an armed conflict. The work was done in remarkably quick time by a large force of carpenters under the supervision of militiamen



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America Prepares as the War Scare Crosses the Atlantic

All public buildings, water works, bridges and strategic points in New York State were vigilantly guarded when word went forth that our Government had broken with Germany. In the photograph above sentries are questioning a man

The armored car with which New York's home defense league is equipped. The car can be used in breaking up riots and dispersing mobs, as well as guarding public stores and charging an enemy. It is manned by a trained staff of army operators

© American Press Assoc

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Bayonet drill at the Lake Bluff, Illinois, camp is part of the routine through which western lads are put before they become full-fledged bluejackets

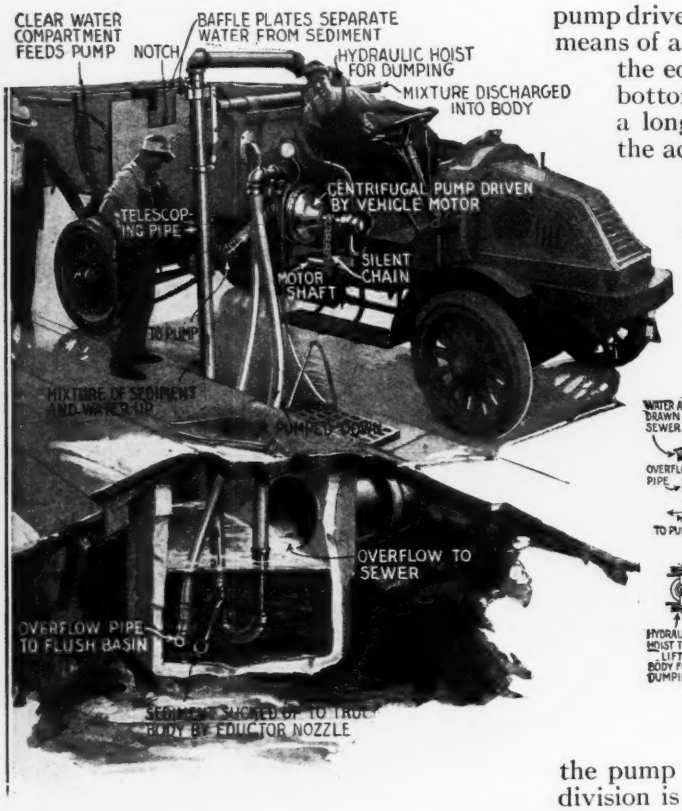
Photos © Amer. Press Assoc.

A member of the American Red Cross Society preparing bandages

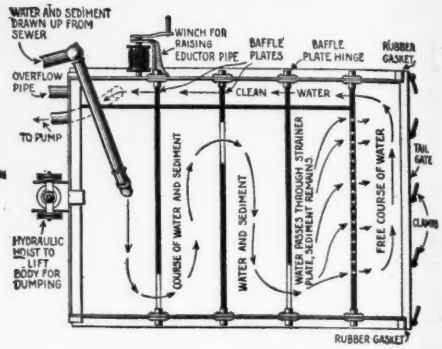
Members of our flying corps studying a model aeroplane in order to become familiar with its operation

The Motor-Truck Sewer Cleaner

It does the work of four gangs of four men each



The machine consists of a five-ton motor-truck with a pumping device which draws the catch basin sediment up and into the truck by suction



SUBSTITUTING mechanical power for hand labor, the ingenuity of a Springfield, Ohio, engineer has found a way to clean sewer catchbasins by motor power. Not only does the machine do the work better than it was done by hand, but it does it more cheaply. The apparatus will clean from forty to fifty catchbasins a day, an equivalent to the work done by four gangs of four men each in the same time.

The machine is a self-contained unit consisting of a five-ton motor-truck equipped with a pumping device. The latter is driven by the vehicle motor and draws the catchbasin sediment up and into the truck body by means of suction. After the body is full, the truck runs to the dump, deposits its load through tilting the body by means of a hydraulic hoist and is back on the job in less than half the time it would take a horse and wagon to make one-half the round trip.

The apparatus consists of a watertight steel box body, an ordinary centrifugal pump driven from the vehicle driveshaft by means of a silent chain, and a device called the eductor which is lowered into the bottom of the catchbasin at the end of a long telescoping pipe, as shown in the accompanying illustration.

The body is divided into two main parts, one for the sediment and one for the water used in the pump to suck up the sediment. This division is made by means of a steel plate parallel with one side and a perforated cross plate at the rear, forming an L-shaped tank for the water. The water is fed from the bottom of the tank into the centrifugal pump directly aft of the driver's seat.

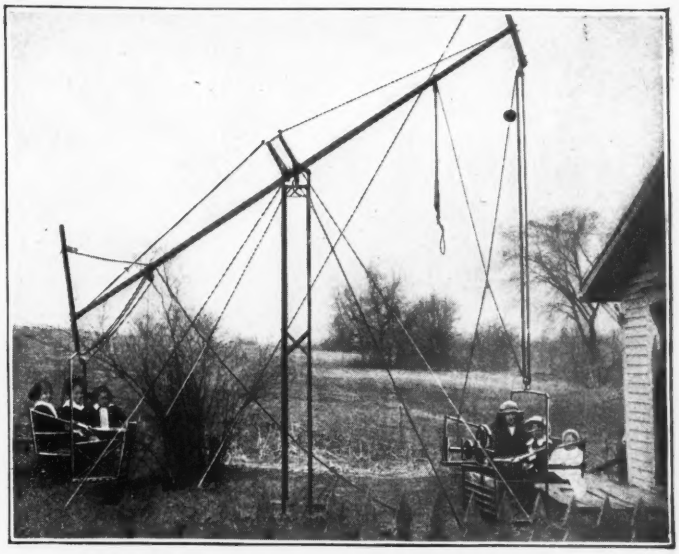
The pump forces the water down into the catchbasin in a hose and up again through the eductor pipe. As it passes the eductor nozzle it sucks up with it the sediment in the basin. The sediment and the water travel through a bend in the top of the pipe and drop into the front end of the truck-body. The sediment falls to the bottom and the water is made to pass through notches cut in opposite sides of three hinged baffle-plates. It passes to the rear and then through the small perforations in the rear cross-plate into the water tank.

At this time the water is practically clear. It is fed to the pump and used over and over again until the truck-body is full of the catchbasin silt.

An overflow valve and hose are provided to flush out the bottom of the basin after all the sediment has been removed.

Water Proves to be a Better Fire Extinguisher Than Dry Powder

DRY powder fire extinguishers, according to recent analyses made for the British Government, contain as their main constituent, bicarbonate of soda. Though this chemical gives off a certain quantity of carbon dioxide when heated, the investigating committee doubts whether it has an effective influence on the action of the powder as a fire extinguisher. Water is said to be far more effective than dry powder. An experiment proved that approximately one cubic foot of gas is formed for each pound of dry powder used.



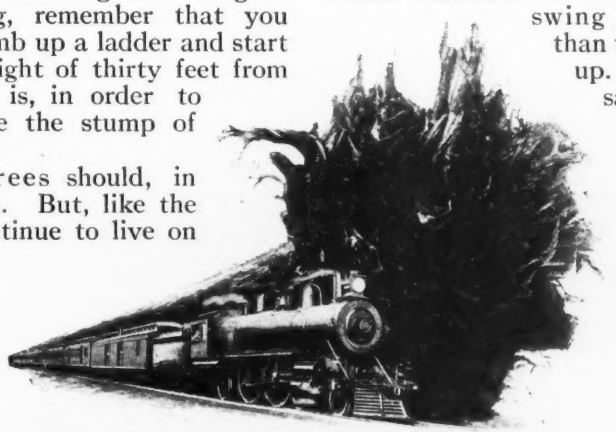
The see-saw swing is operated by simply turning a handwheel located in front of the occupants of the chairs

How a Giant Redwood Compares with a Locomotive and Train

A GIANT redwood, uprooted and lying prone alongside a railroad engine coupled to eight long passenger cars, as in the illustration below, gives a better idea of the immensity of these huge trees than any statement of length or diameter in figures. The redwood is in the vegetable world what the elephant is compared to land animals or the whale compared to the other denizens of the deep.

Probably the tallest of these big trees is the Columbia, 294 feet—a hundred yards. Pace off one hundred yards and see what you think of it for the length of a log, and then if you were thinking of sawing or chopping this log, remember that you would have to climb up a ladder and start chopping at a height of thirty feet from the ground, that is, in order to make a cut above the stump of the tree.

These great trees should, in reality, be extinct. But, like the elephant, they continue to live on in an age when their contemporaries are studied only in the form of fossil remains. It is almost impossible to estimate their age.



A redwood tree uprooted and lying prone beside an eight-car passenger train for size comparison

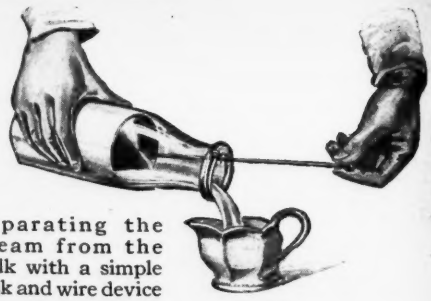
A See-Saw Swing Which Children Can Safely Operate

A LARGE swing which children can safely operate has been devised by Edward Hardy, of Blandinsville, Illinois. There is a long cross-beam supported from a high standard. A swinging chair is suspended at each end. Located in front of the occupants of the swing is a handwheel. Turn this handwheel and the swing is operated. Turning the handwheel winds up the cable over the rod with which the handwheel is connected by a series of gears. A downward pull on the free end of the cable causes the swing chair to move inward on the see-saw frame toward the central standard so that one end of the swing becomes lighter than the other and goes up. It is not necessary for the occupants of the seats to be of equal aggregate weight, as the shifting of the chair makes up for any difference.

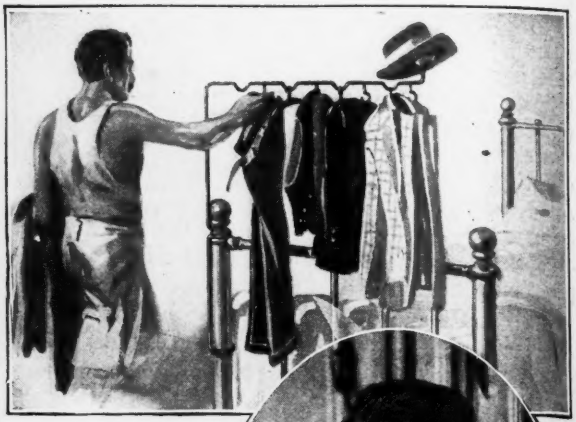
A half-dozen children can be safely amused for hours by means of this clever contrivance.

Housekeeping Made Easy

A foot control enables the operator of the motor-driven sewing machine to stop or turn on the current as desired by pushing a pedal down or up



Separating the cream from the milk with a simple disk and wire device

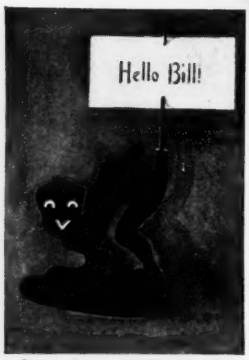


A clothes rack attached to the head or foot of the bedpost can be adjusted to any position

Above: Pasquale Amato, the operatic baritone, talking into a telephone that to all appearances is a paper doll

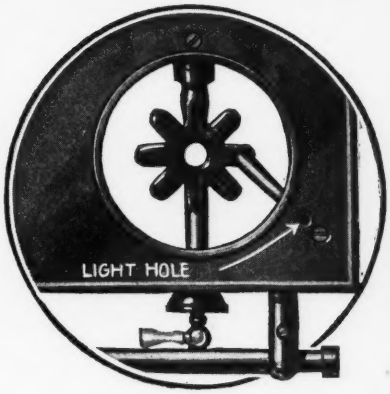
A combined pan cleaner and scraper. The scraper is of steel and the cleaner of cloth or broom bristles

A table which has an invisible compartment directly under its top for storing away the extra leaves



A unique bill file in the form of a defensive cat with the tail sharpened to a point at the end to receive the bills

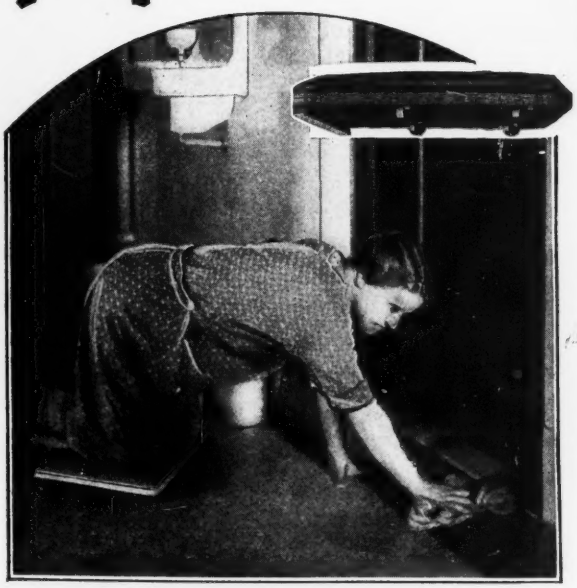
Housekeeping Made Easy



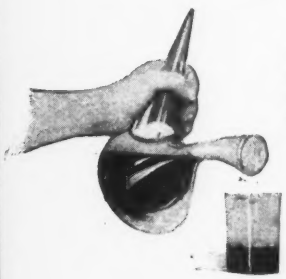
A device for lighting the gas-stove through an opening in the burner plate. In this way the flare or "popping" is eliminated

A candlestick for hall or living room. It has three adjustable candle supports. The standard is made of solid mahogany

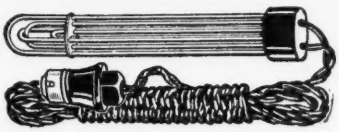
With this device a needle bath and massage can be given at the same time. The water is contained in the cylinder on the wall and comes through the brush in the form of a needle spray



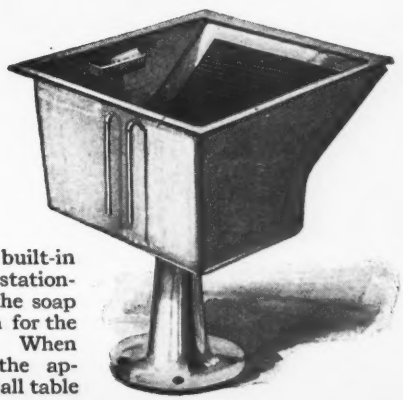
A scrubbing-car knee-rest which protects the scrubber's knees and clothing and saves time in moving along the floor. It slides along as if on casters



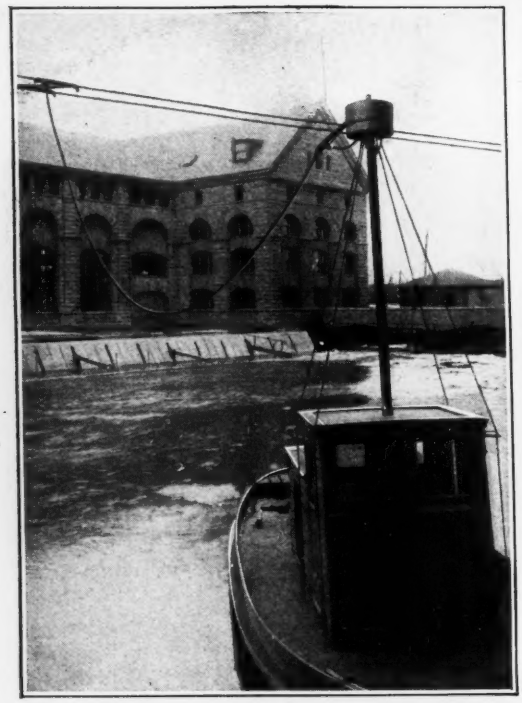
The "porron" used by the Spanish peasants for wine, makes a quaint addition to the salad equipment. Either of the spouts may be used for a handle



An electric water purifier which is placed immediately in the water and the sterilizing current turned on



A washtub with a built-in washboard and a stationary container for the soap will prove a boon for the small apartment. When covered it has the appearance of a small table



The little trolley boat has solved the problem of preventing canal ice from accumulating

Trolley Cars on the Water? Yes; and in New York State

IT seems reasonable to conclude that if the electric trolley boat illustrated were introduced into Amsterdam or Venice, it would soon develop into a practical and popular "jitney boat."

The craft shown is by no means an experiment, but was designed to break up ice jams and prevent them from clogging the intake canal of one of the great power companies of Niagara Falls. The ice problem has always worried the water power enterprises at Niagara. Large cakes enter the canal from the Great Lakes. To prevent these from accumulating near the power houses, where they would immediately check the flow of water necessary for operation, the boat is used.

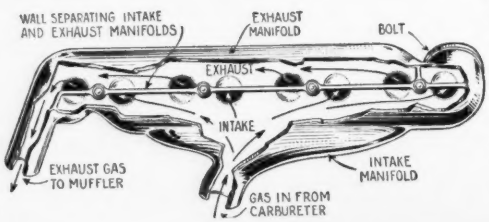
The hull of the boat greatly resembles that of a submarine as it is made entirely of steel. Although the craft is only eighteen feet long, it carries a seventy-five horsepower motor which gives it unusual power to buck the huge ice cakes out of the way.

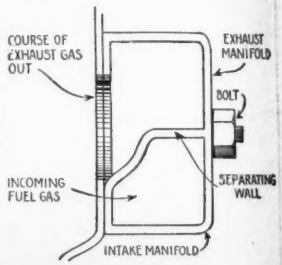
Increasing the Power of Automobile Engines with Mufflers

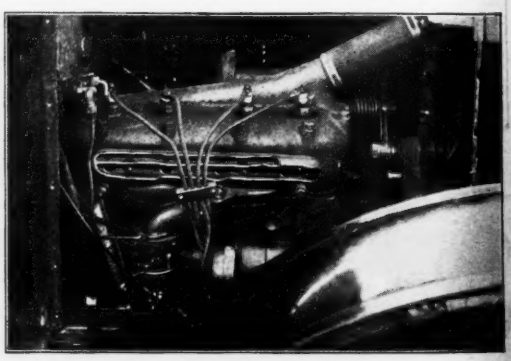
GREATER power is secured from an automobile engine if the exhaust gases are completely rather than partially removed from the cylinders just before each power stroke. While this can be accomplished if the motor has but one cylinder it is more difficult when two or more cylinders are employed, for the reason that two or more cylinders are connected through the exhaust manifold. This is due to the overlapping periods during which the exhaust valves are kept open.

Under such conditions, the resistance or back pressure caused by the gases forced to pass through a muffler tends to make the pressure of the beginning exhaust hold back the gases in the cylinder from which the exhaust is nearly completed. This decreases the volume of new fuel gas and lessens the power from its explosion.

These conditions have been largely overcome by the invention of an Indiana engineer, in which a number of mufflers are employed. In the case of the six-cylinder motor shown in the accompanying sketches two mufflers are used. Each is connected with three cylinders so that successively exhausting cylinders operate through different manifolds instead of the same one. By this means, only one exhaust valve is open at a time.



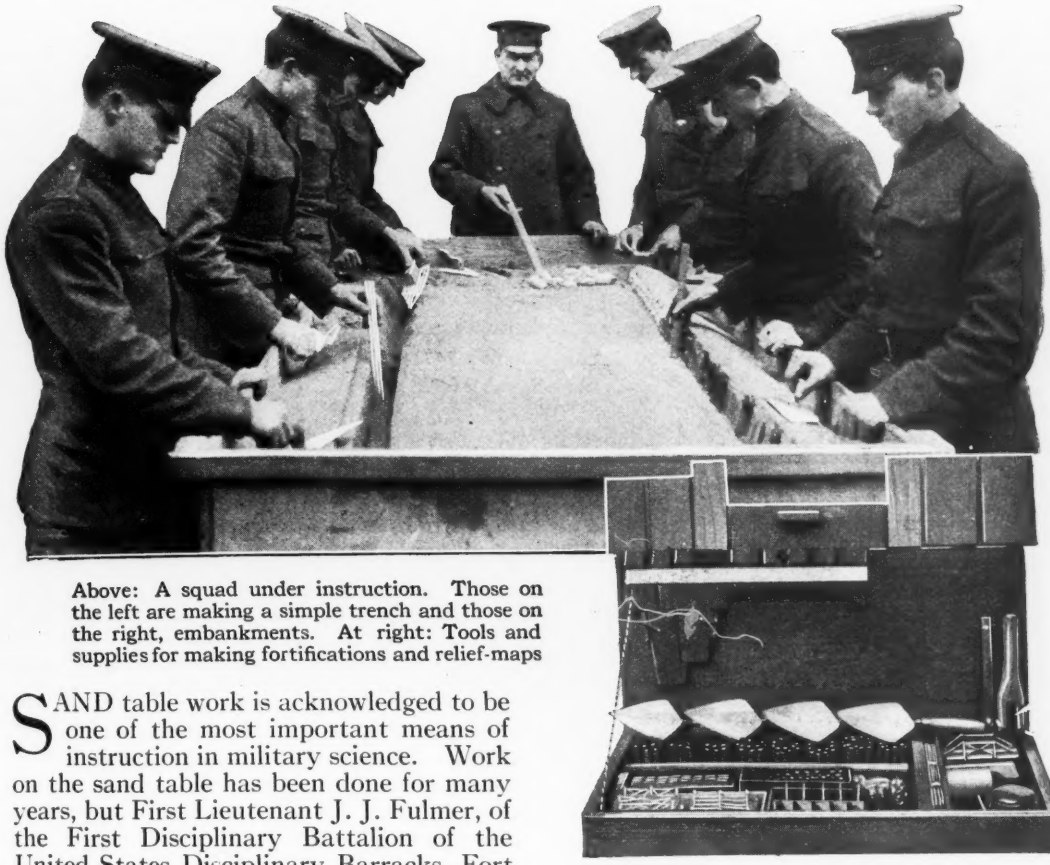




Each of the mufflers is connected with three cylinders so that successively exhausting cylinders discharge through separate manifolds

Teaching Our Soldiers How to Fight

Problems in minor tactics are worked out in models of mud

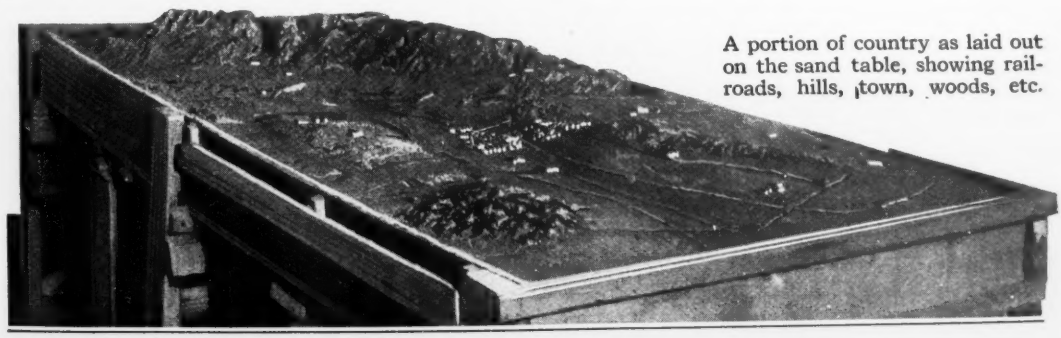


Above: A squad under instruction. Those on the left are making a simple trench and those on the right, embankments. At right: Tools and supplies for making fortifications and relief-maps

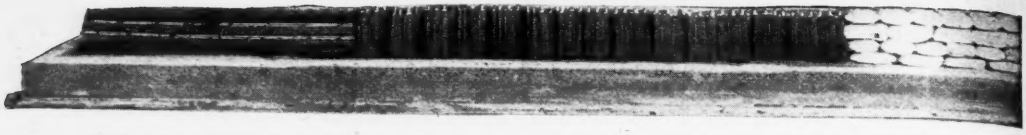
SAND table work is acknowledged to be one of the most important means of instruction in military science. Work on the sand table has been done for many years, but First Lieutenant J. J. Fulmer, of the First Disciplinary Battalion of the United States Disciplinary Barracks, Fort Leavenworth, Kansas, has introduced into the work scientific exactness.

The sand tables used are ten feet long, four feet wide and three and one-half feet high to top of box, and the box is eight inches deep. Sand is put in the box to a depth of six inches. It is well watered with an ordinary watering can.

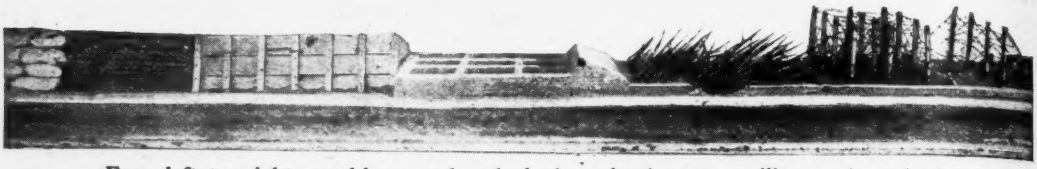
Two sets of implements are used. One is known as the fortification set and the other as the terrain set. The fortification set contains eight gabions (round, bottomless baskets, filled with earth), four fascines (bundles of sticks bound together) four hurdles, twenty bags for sand, one box of blocks, representing sod, and one bundle abatis (obstacle composed of felled trees). Besides these there are trench models and material to represent hills, woods, streams, railroads, bridges, concrete, king post,



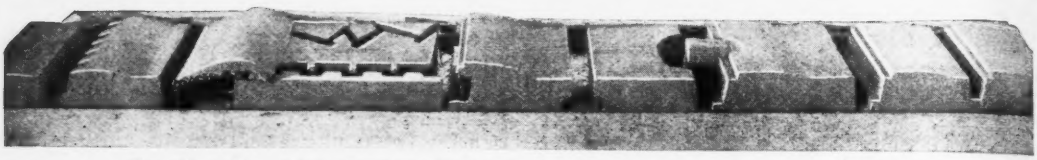
A portion of country as laid out on the sand table, showing railroads, hills, town, woods, etc.



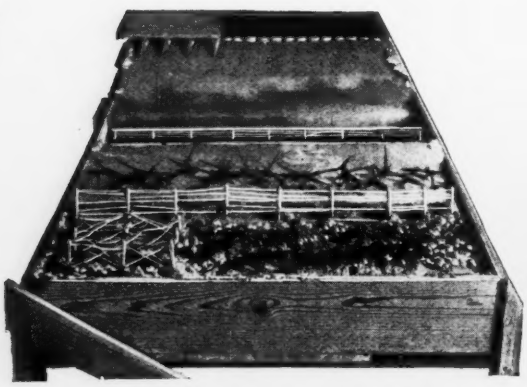
Embankments and obstacles. Reading from left to right, fascines (sticks bound together), gabions (bottomless baskets filled with earth), hurdles and sand-bags



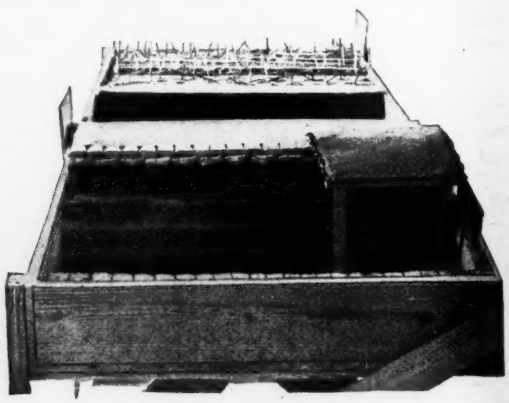
From left to right, sand-bags, sod and plank embankments, military pits, abatis (pointed obstacles), wire entanglements and wire fence with apron on each side



Samples of trenches, showing simple trench, enlarged trench, trench with traverse sections, communicating trenches and trenches with individual firing positions



Rear view of a portion of field fortifications of different kinds made on the sand table



Front view of the same. Note abatis, wire entanglements, wire fence and shelter

queen post, pontoon, railroad trestle, one train, railroad, water tank and about fifty buildings, as well as glass for representing bodies of water. This set teaches map-reading and contours, and with it it is possible to do work in outposts, scouting and other problems in minor tactics, far more satisfactorily than on the map.

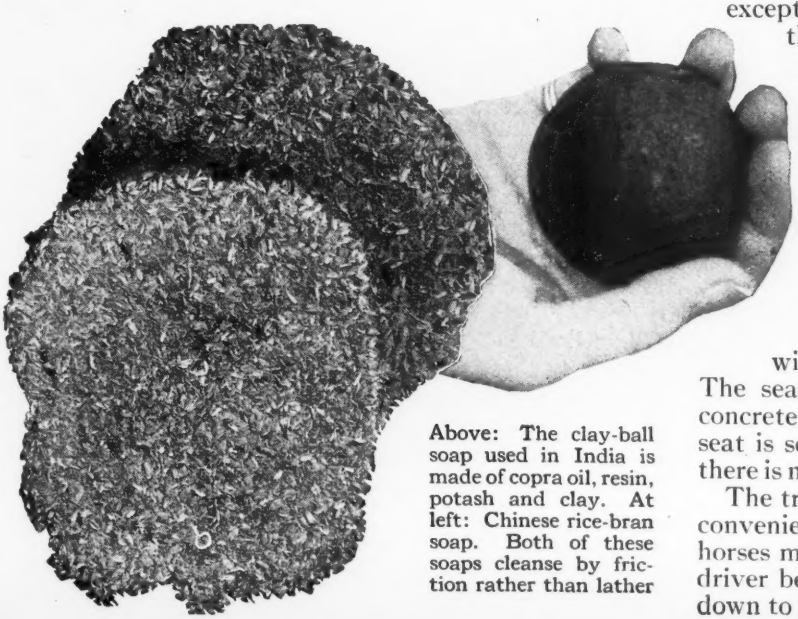
The terrain set contains a section of wire fence, a section of wire loops, a section of high wire entanglement, a section of low wire entanglement, a section of *chevaux de frise* (spiked obstacle) and a form for fire trench with attachment for enlarging. This set also has the following tools: one surface float, two road markers, two railroad markers, one leveling roller, one folding rule and one trowel. Work with the terrain set gives the soldier a fair idea of a big military problem and of his personal importance in it. It does not restrict him to the small section of ground he would see while actually engaged in his duty. On the sand table he is enabled to work out his own route in patroling or scouting, and it gives him a far clearer idea of the problems involved as a whole than he could possibly get otherwise. This work has been found to stimulate the private's interest to such an extent that he is gradually fitted for assuming any responsibility which an emergency may thrust upon him.

It Would Take a Book to List the World's Soap Curiosities

THERE are varieties of soaps to suit every taste and clime. There is the dainty fit-the-palm toilet soaps of the harem, with the national star-and-crescent emblems of Turkey inscribed on them; the soaps of the Holy Land and Armenia, with their Arabic legends; the floating, violet-perfumed soaps of the Greek coast; the human-fat toilet soaps of Paris, and others too numerous to mention.

The two soaps illustrated below, however, may be put in the class of the super-curious. One is the primitive Chinese rice-bran soap and the other is the clay-ball, floating soap so popular with the natives of India. With each purchase of rice the Chinese housewife expects a small quantity of rice-bran. About a teaspoonful of this bran is placed in a small muslin bag and boiling hot water poured over it, making a thin, gruel-like fluid. Using the bag as a friction brush the skin is effectively cleaned without utilizing any of the animal fats.

The clay-ball soap is made of copra oil, potash, resin and a clay resembling infusorial earth. The color ranges from dark brown to black brown. The dusky-skinned boys of the Malabar Coast not only use this soap for toilet purposes but they play ball in the water with it.



Above: The clay-ball soap used in India is made of copra oil, resin, potash and clay. At left: Chinese rice-bran soap. Both of these soaps cleanse by friction rather than lather

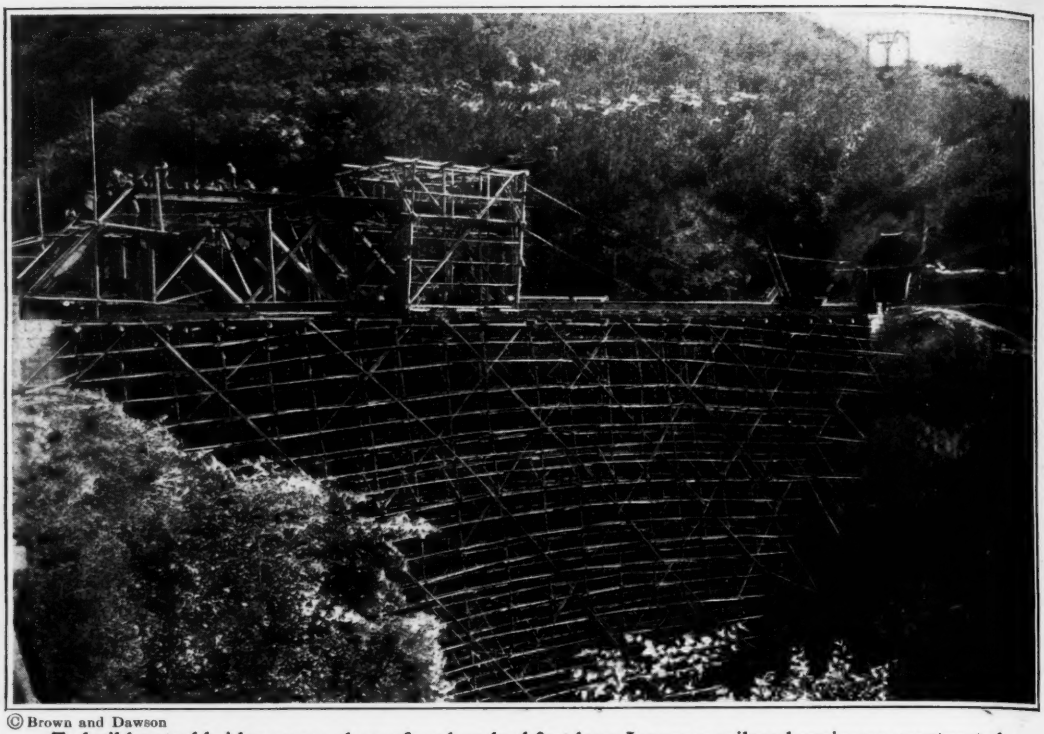
This type of watering trough provides a resting-place for pedestrians and a shelter from sun and wind for the horses. It takes up comparatively little space

The Two-in-One Idea as Applied to Watering Troughs

THE commodious and substantial-looking street rest, shown in the illustration, is an example of the way the citizens of San Francisco conserve their street space and combine utility with ornamentation. Formerly an old-fashioned watering trough on four massive legs took up about thirty-six square feet of the corner, which is an exceptionally busy one near the heart of the city.

The new arrangement shuts off the sight of the watering trough entirely from the sidewalk and provides at the same time a resting place for pedestrians and a shelter from sun and wind for the horses. The seat and trough are of concrete and the back of the seat is so wide and high that there is no danger of splashing.

The trough is arranged at a convenient height, so that horses may drink without the driver being compelled to get down to loosen the check-rein.



© Brown and Dawson

To build a steel bridge over a chasm four hundred feet long Japanese railroad engineers constructed their temporary falsework of bamboo. This intricate network of poles is four hundred feet high

A Grass Bridge. A Remarkable Feat in Civil Engineering

SINCE bamboo is a grass the bridge illustrated is literally a grass bridge, its supports consisting of thousands of bamboo poles tied together to form a temporary falsework. The intricate structure is the work of Japanese bridge builders who were obliged to construct the bridge without interfering with railroad passenger and freight traffic. Because lumber is scarce in Japan the engineers had to rely upon the serviceable bamboo.

The bridge is four hundred feet long and one hundred and twenty-five feet high. As will be seen in the photograph the two masonry bases of the bridge are already completed. Two steel members already span the canyon, supported by the bamboo poles. The largest pieces of wood to be used in the construction of the bridge are those forming the superstructure—round poles supporting the weight of the top steel beams. When the steel bridge was completed the bamboo falsework was taken apart and removed to the next bridge-building job. Bamboo is a long wearing material so that the framework may be used over and over again.

A New Use for Rhubarb. You Can Clean Pots with It

ALUMINUM has won the housewife's endorsement as a most satisfactory ware for kitchen utensils. But the kitchen maid is not so well pleased with it. Its beauty lies in its brightness, and when it is discolored, "Madame" is so particular about how it is cleaned. If it is scoured, care must be taken that it is not scratched in the process.

Scraping must always be done with a wooden spoon since aluminum is soft and scratches easily. Strong alkalis are not available because they attack and dissolve the metal. Only mild soaps must be used. How then can that horrid discoloration be removed? It is very simply done.

Take a piece of rhubarb, either fresh or canned, cut it into small pieces and boil the pieces in the discolored kettle until it is clean. The acid of the rhubarb will remove the discoloration without in any way injuring the metal. Of course the rhubarb used for the purpose must be thrown away afterwards. When a vessel has been cleaned in this way it will need only a little rubbing up to secure a bright metallic surface.

Making Clothing from a Fabric Woven from Nettle Fiber

WE agree that war is—all they say it is. But the spur of necessity which it has applied has brought forth a host of inventions and new ideas. Today, because cotton and wool have been requisitioned for the armies and supplies for general purposes have been curtailed or cut off, the Germans are making a soft, lustrous material from the fiber of nettles. It is thin and strong and makes up beautifully into articles of clothing.

Several years ago experiments were made with nettle fiber but difficulty was encountered in separating the fibrous from the vegetable matter. Muriatic acid was used for the purpose, and a dessicating process was also tried, but results were unsatisfactory. The method now used overcomes all difficulties and leaves the fabric soft and pliable enough for any use.

Special crops of nettles are now being cultivated. There are twelve thousand trustees and public officials promoting the collection of them.

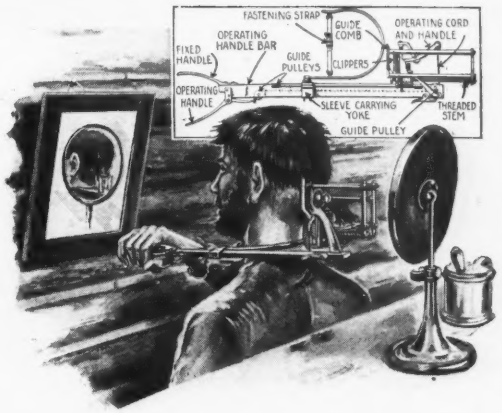
Was This Inspired by the Recent Prohibition Movement?

WINE bottles exposed on the sideboard may be perfectly useful articles. But when the prohibition advocate comes to call, there is a grand rush to clear them away. A New York woman comes to the rescue with a hollow doll into which said bottles always disappear when not in use.

These considerate dolls, as the illustrations show, are made to fit over the bottles, completely concealing them. The main portion of the bottle is concealed by the body of the doll and the clothes in which it is dressed.

The hollow doll, pushed down over the neck of the bottle, completely conceals it from view

The head of the doll is hinged and is shaped inside to fit the top of the bottle. You have only to throw back the doll's head to pour out a drink. The device might also be used to conceal large-sized medicine bottles on the table of the sick-room.



The front handles are held in one hand and are continually drawn in and out by pressure

Strap It on Your Neck and Cut Your Hair Yourself

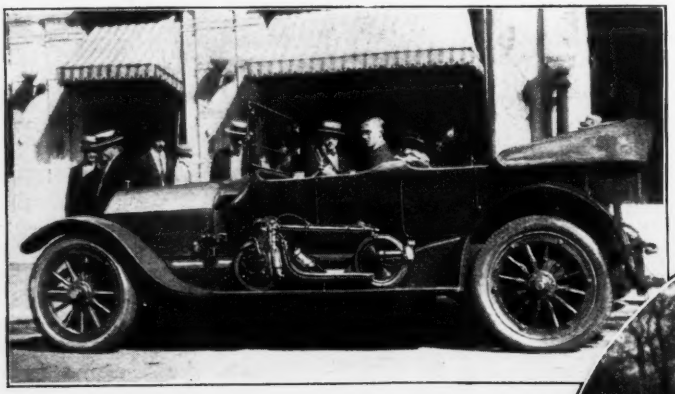
SHOULD every barber in the United States go on a strike the invention pictured above would surely prove popular.

You strap to your neck a yoke somewhat similar to that used on oxen. On one side of this, a carrying-bar is pivoted; on the rear end a hair-clipper is held, while on the front end are operating handles. The clipper consists of a number of shears somewhat like sheep-shears operated by two levers attached to the clipper. A guard is provided to keep these a safe distance from the head. There is a string-and-pulley arrangement connecting the front operating handles with the two levers so that the levers may be worked by the handles when the "operation" is progressing. To use the apparatus you simply adjust the clipper the distance from the guard at which you desire to cut your hair (thus regulating the length), keep the handles going and move the clippers about by swinging the carrying-bar upon its pivot until the entire head has been gone over.

The Gasoline Caddy and Errand Boy

With a gasoline foot-cart one boy does the work of three

A GROCER on Manhattan Island, New York, has bought a gasoline foot-cart for his special delivery service. The result has been an increase in business as well as a saving in money of $21.60 a week. Formerly this grocery, which also handles meat, paid three boys to handle special rush orders for late dinners at the rate of twelve dollars each a week in addition to their expenses of about six dollars a week. One gasoline foot-cart now does the work of the three boys.



At left: The foot-cart is used as a tender on the automobile to summon help to the car in a hurry

Below: The golf caddy finds it a convenience and an economizer of time and temper over the links

Gasoline and oil for the gas-cart costs about forty cents a day, each day's work averaging one hundred miles. The machine itself costs only one hundred dollars. Hence the grocery saves over $1100 a year. Even if a new cart is bought every year the annual saving is still one thousand dollars.

The delivery boy speeds away at the rate of twenty-five miles an hour with his basket on his arm

The foot-cart is also being used by golf caddies; by salesmen who make many calls a day; by a theatrical producer who uses it as a tender on his automobile to summon help in case the large machine gets into a mudhole when he is in a hurry to be on his way, and by factory messengers in large plants.

This miniature one-passenger machine has a pressed steel platform, suspended about four inches from the ground between pneumatically tired wheels. The motor is attached to the front wheel. The rider stands while driving and his weight is carried between the wheel centers, so that the balance is easily maintained. He leans on the handlebar for support and to steady himself, steering and controlling the operation of the machine at the same time. Both the brake and the clutch are operated by moving the handlebar forward or backward. The speed can be regulated as desired, twenty-five miles an hour being about the maximum.

The delivery boy carries his basket on his arm, and if he has other bundles to be delivered on the same trip he secures them to the sloping front of the foot-platform and sails away with perfect ease and evident enjoyment. His machine is so narrow that he can make his way through crowded thoroughfares without slackening speed.

Shoot Your Deer from Horseback with This Saddle Gun

IN the Southern part of the United States game is sometimes shot from horseback. Only experienced hunters can handle a horse and keep a gun steady at the same time. In order that the "tenderfoots" of a party may do some of the shooting too, a West Virginian has devised a saddle-mount for their guns. By its means a gun can be swept in almost any position and steadied until fired.

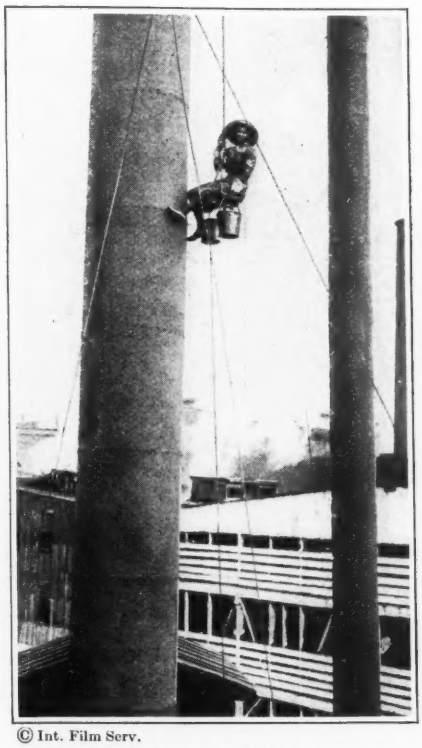
This is accomplished, as the illustration shows, by a treble-jointed mounting. The first joint is a swivel, allowing the gun to be swept horizontally. The second, a ball-and-socket joint, permits motion in a vertical direction. The last of the joints enables the entire gun to be moved sidewise with respect to the horse. The ball-and-socket, of course, allows very fine adjustments to be easily made; so that between the three joints, a gun can readily be aimed in the exact direction that would be required and held perfectly steady until fired.

Three different joints on the gun saddle enable the gun to be swept in any direction

How a Young Woman of Kentucky Rose to Great Heights

"NERVES for the women, but nerve for the men" was the unexpressed distinction drawn before the days of the suffragette and of the great war. Although the female of the species may still scream at sight of a mouse, she has proved equal to so many emergencies that it can no longer be said that "nerves" are her distinguishing characteristic.

A case in point is the young Kentuckian in the accompanying photograph. She is Miss Mayme Pixley, and she became a steeplejack by chance, not by choice. Her father, who is the senior member of the present steeplejack partnership, had a contract for painting seventy-five smokestacks for a large distilling company, when he fell and broke his leg. The Pixleys felt that they could not afford to lose that contract, so Mayme (we like the Broadway spelling of her name) stepped into the breach—or rather into the breeches—and proved that she could wield a paintbrush as efficiently at the top of a smokestack as she could around the table-legs in the kitchen.



© Int. Film Serv.

Her first job was painting seventy-five smokestacks for a distilling company. She did it practically alone and in a satisfactory manner

She finished all of the seventy-five stacks and received the full contract price. That was six years ago. Mayme is still rising in the world upon occasion, with her paint-pots swinging beside her and her father meeting her strokes on the opposite side of the stacks.

Although she does not claim to be a "new woman" or to have very advanced ideas on the question of woman's place in the world, Mayme believes that a mere matter of skirts should not be allowed to stand in the way of work to be done if one is able to do it.

What a million dollars in gold looks like. The fifty thousand twenty-dollar gold pieces in this display weigh one and seven-eighths tons

Did You Ever See a Million Dollars in Gold? They Weigh Nearly Two Tons

IN a recent celebration held in San Francisco, one of the chief attractions was a pile of a million dollars in gold. The privilege of having a good look at all this money was given the guests by the City Treasurer who offered to make the display before the coins were released on their separate adventures in the business world.

There are fifty thousand twenty-dollar gold pieces in this display, which means that nearly two tons of gold had to be brought from the treasury. The coins were all minted at San Francisco within the past year; and if they were placed one on top of the other, a pile four hundred and seventeen feet high would be formed. Such a pile would be nearly one and a half times the height of the large dome on the Federal Capitol at Washington.

Look Out for Automobile Gas—It Is Fatal

ARE you in the practice of "warming up" your automobile engine in the garage with the doors and windows closed? If so, you stand a good chance of being asphyxiated by the exhaust gases. So imminent, indeed, is the danger, that the United States Bureau of Mines has sent out a warning against operating automobile engines in small garages where the ventilating facilities are poor.

According to the Bureau the air in the garage is rendered decidedly dangerous after the automobile engine has been running fifteen minutes. The gas is carbon monoxide; it is colorless, odorless, tasteless and is extremely dangerous. The symptoms of carbon monoxide poisoning come almost without warning, says the report, and collapse in a garage generally proves fatal, unless outside aid arrives very soon.

The Convertible Knapsack—It Can Be Changed Into a Tent at Night

A NEW YORK sporting goods house has lately placed on the market a knapsack which ought to put fifty per cent more fun into a hiking trip. The knapsack does away with the bother of carrying a tent around—for the knapsack itself is merely changed into a tent for the night.

The knapsack is unlaced into the dog-tent shown in the illustration. There are flaps at the side which can be used to give proper ventilation. A number of pockets are also built in the side. In these, all the ordinary articles of camping can be placed. After a bivouac, the tent can be refolded and turned back into a knapsack. The entire outfit can be stored in the inside of the knapsack out of the way. The knapsack is laced up and strapped on the shoulders where it will require no further attention from the traveler.

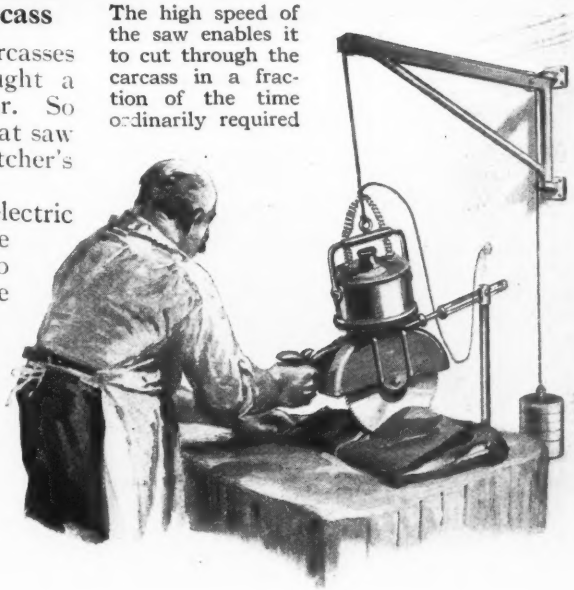
The problem of camp luggage is solved by this knapsack which can be opened out to form a comfortable tent or laced up into a compact luggage-carrier

Whiz, Whiz Goes This Electric Buzz-Saw as It Cuts Up a Beef Carcass

WHY shouldn't beef and other carcasses be cut up electrically, thought a California inventor, Frank F. Wear. So he invented a high-speed electric meat saw which saves two thirds of a busy butcher's time.

Wear's saw is driven by a small electric motor mounted directly above the blade itself. The motor is geared to the saw, and rotates it while the butcher guides the apparatus over the carcass by a handle.

When a carcass has been placed on a cutting table, an electric button on the handle is pressed, whereupon the motor begins to spin. No sooner has the saw been brought down than it rapidly imbeds itself in the carcass. It is carefully guided as it cuts through meat and bone, and in no time the carcass is severed.



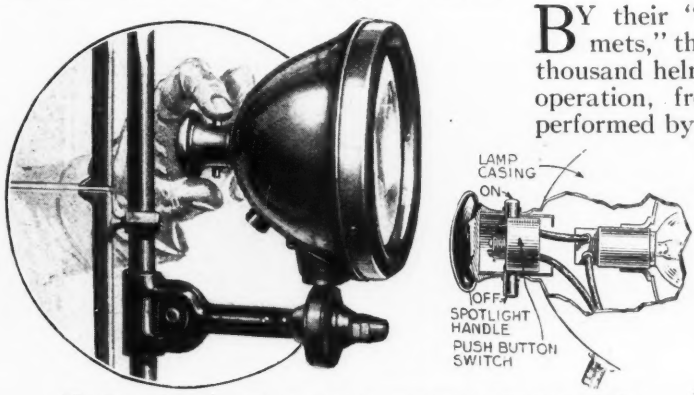
The high speed of the saw enables it to cut through the carcass in a fraction of the time ordinarily required

Regulating the Automobile Searchlight by a Simple Push Button

A WESTERN manufacturer of automobile searchlights has introduced an ingenious method of controlling the circuit to the lamp by means of a small push-switch similar to those installed in handles of electric vibrators, vacuum cleaners and tools. Heretofore it has been necessary to regulate the lighting of a searchlight either by means of a switch on the dash, which is somewhat inconvenient, or else by means of a loose plug extending from the lamp.

The new method makes it possible for the hand that moves the lamp in various directions also to control the current simply by pushing buttons. When the light button is pushed the current is "on" and the lamp is lighted. When the dark button is pushed the current is "off."

The switch, sometimes called a "tool-handle" switch, has an insulating tube which is placed inside the small neck of the lamp. A sleeve of insulating fiber protects and separates it from the metal shell. The push buttons are placed in position after the switch is slid into the neck of the lamp.



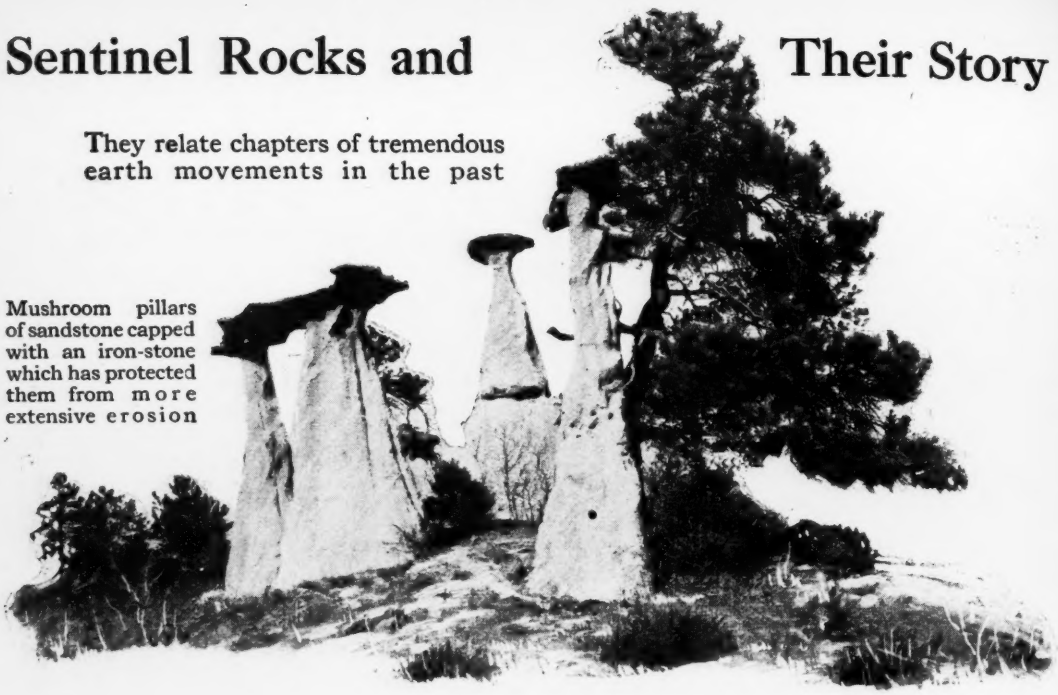
The lamp is operated by simply pushing the button. This makes it possible to swing the searchlight in any desired direction and to regulate the lighting at the same time

Turning Out Helmets for the French by the Thousand

BY their "quantity production of helmets," the French are turning out fifty thousand helmets daily. Practically every operation, from cutting to painting, is performed by machinery. Each helmet is made from four pieces stamped from sheet steel. After the pieces are rivetted together, the helmets are sent to the painting room. Here machines are used to spray the paint on the helmets and in the crevices formed by the rivetted pieces. Then the lining and chin straps are made and adjusted.

Sentinel Rocks and Their Story

They relate chapters of tremendous earth movements in the past



Mushroom pillars of sandstone capped with an iron-stone which has protected them from more extensive erosion

THE western portion of the United States is full of strange rock forms—lofty natural towers, pinnacles and monuments, many of commanding dimensions. Some of the rock towers are composed of relatively soft material, such as sandstone, and their history has been one of rapid erosion and disintegration; others of granite stand seemingly unchangeable, yet their very forms show that they too have been the playthings of the elements.

The light-colored sandstone mushroom-like pillars which are numerous in the vicinity of Monument Park, Colorado, are the visible remnants of a great bed of such sandstone, which in a past geologic age covered this portion of the United States. At intervals through this bed of sandstone there were thin strata or layers of a harder iron-stone, fragments of which are now seen as cappings of the sandstone pillars, protecting them to a considerable degree from erosion. The altitude of these sandstone rocks is about five thousand feet above sea-level, yet they were the ocean's bottom.

At another point, near the Garden of the Gods, Colorado Springs, the rock towers are of a somewhat harder sandstone. The Major Domo, as it is called, is one of the most striking of the sentinel rocks of this strange garden. It is of red sandstone, and one of the remnants of a great bed of stratified sedimentary rock which, in the upheaval of the Rocky Mountains, was actually turned on edge. The "grain" of the rock, therefore, now runs vertically whereas originally it lay flat.

The leaning pinnacle surmounting one of the ridges of the West Elk Mountains, in Colorado, is a rock of great strength and resistance to erosion.

The ridge consists of rock which was long ago forced up from the bowels of the earth, hot and liquid, and intruded into the layers of sandstone and other sedimentary rocks nearer the surface in a mass several thousands of feet thick. It then gradually cooled, consolidated and partially crystallized into hard rock. Later, erosion stripped off the sedimentary rocks and carved the hard rock into one of the West Elk Mountains, on which may be seen untold numbers of such pinnacles.

The big Bad Lands of South Dakota constitute a large area of very soft clayey sandstone which was once the bed of a great inland sea. It is now a well elevated region and the elements have cut and carved the rock into every conceivable shape. There are human and animal faces and forms, and towers and ruined castles and palaces, a perfect riot of possible and impossible shapes. The disintegration is in comparatively rapid progress and the soft rock is continually scaling and falling away from the columns and pinnacles.

Sculpture That Was Centuries in the Making

At right: In the Bad Lands of South Dakota the soft clayey sandstone has been cut and carved by the elements into many fanciful shapes

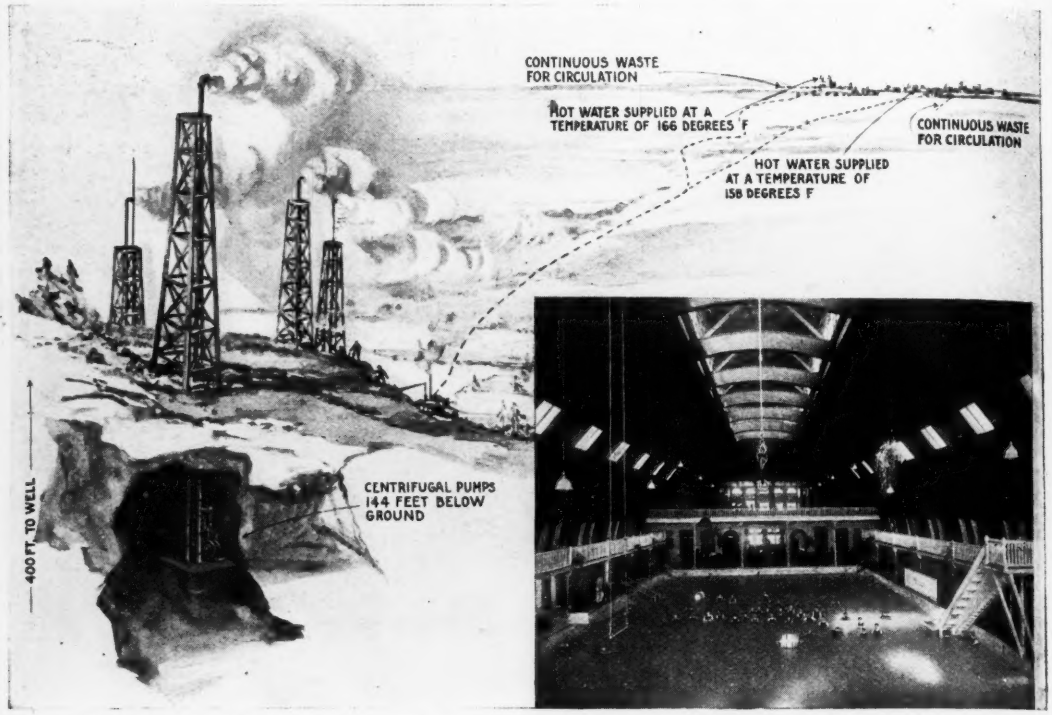
The Major Domo, a remnant of a bed of stratified rock which in the upheaval of the Rocky Mountains was actually turned on edge. Note the human figures to which the arrow points for height comparison

The leaning pinnacle of the West Elk Mountains in Colorado. The surface is composed of a series of pinnacles like the teeth of a giant saw. It guards an impassable ravine of ungaged depth

Sentinel Rock, at the mouth of Sentinel Creek in Glen Canyon, Utah. From one point of view the rock is said to resemble a woman

Nature Supplies Boise with Hot Water

How the city uses boiling artesian water for its swimming pools and its laundries


CONTINUOUS WASTE FOR CIRCULATION
HOT WATER SUPPLIED AT A TEMPERATURE OF 166 DEGREES F
CONTINUOUS WASTE FOR CIRCULATION
HOT WATER SUPPLIED AT A TEMPERATURE OF 158 DEGREES F
400 FT. TO WELL
CENTRIFUGAL PUMPS 144 FEET BELOW GROUND

Four wells supply Boise with nearly a million gallons of hot water a day

The swimming pool at Boise which receives its natural hot water from inexhaustible springs

THE city of Boise, Idaho, has a curious hot water supply—a natural artesian flow of 800,000 gallons of water a day with a temperature of 171 degrees Fahrenheit which is only 41 degrees below the boiling point. In addition 450,000 gallons a day are pumped. School buildings, hotels, boarding houses, laundries and residences to the number of one hundred and thirty-eight are supplied with the hot water, both for heating and domestic use, and during the summer months sixty additional buildings are supplied. The great Boise natatorium, a building 215 by 200 feet and over 100 feet high, with a swimming pool 65 by 125 feet and with shower and other baths, uses this natural hot water. The water is believed to have great medicinal and stimulative properties, because it contains a large percentage of soda, potash, lithia, magnesia, iron, etc.

The water comes from four wells 400 feet deep, two of them eighteen inches in diameter and two six inches. The larger wells are equipped with centrifugal pumps located 144 feet below ground. One of these raises the entire available supply of water, the other is held in reserve. With no pumping, the natural flow is 800,000 gallons daily, which is one of the heaviest artesian flows known, either hot or cold. Only a few wells in the United States have developed over 1,000,000 gallons a day, even with pumps.

The Boise wells are owned by a hot and cold water company, and, while others have driven a number of wells on adjacent land, no additional hot water supply has been developed. The use of this natural hot water for heating purposes extends back for a period of twenty-five years, but it is only within the last few years that the available supply has been fully developed for general use.

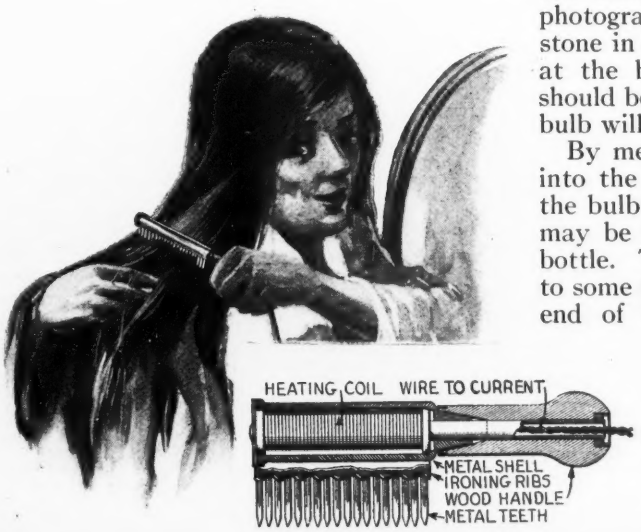
The maintenance and operation of the hot water part of the system requires a force of four men during a period of eight months and one man for the remaining four months of the year when the wells are operated without pumping. The piping in the natatorium and other buildings where the water is used corresponds to that of the ordinary system of hot-water heating.

An Electric Comb for Drying the Hair After the Shampoo

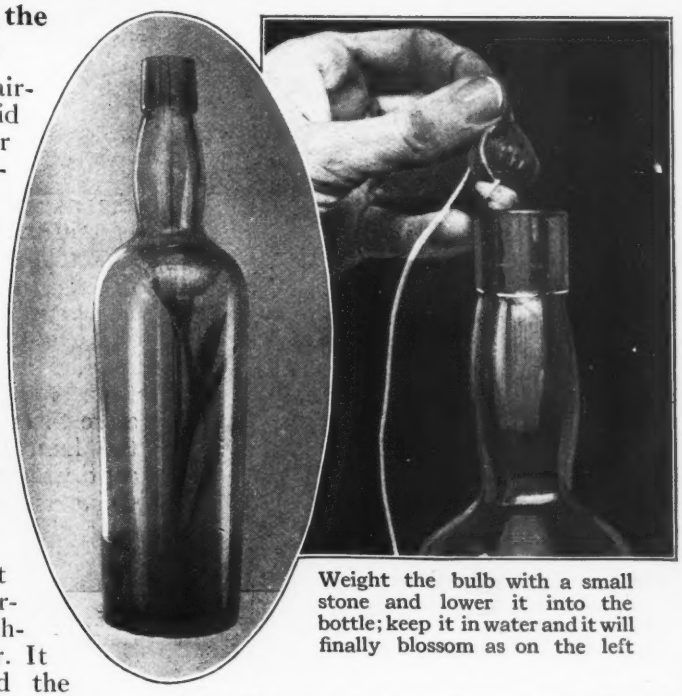
HERE is a boon for the hairdresser, barber, lady's maid or for the woman who is clever enough to shampoo herself without assistance. It is a comb so constructed as to inclose an ordinary electrical heater. The body portion of the comb, hollow and cylindrical, is provided with grooves into which the teeth of the comb fit. The electrical heater is contained in this hollow cylinder. Extending through the tang and the handle, is a metal tube which serves as a conductor running to an ordinary lamp-socket.

The comb may be taken apart and cleaned and thoroughly sterilized in a sterilizing liquid without danger of wetting the heater. It is as easily reassembled, and the parts fit together so snugly that there is no rattling or unsteady movement during the operation.

The amount of electricity used is small but is sufficient to dry the hair thoroughly in a very short time. Thus in a single operation the two most tedious accompaniments of the shampoo are accomplished; for when the hair is perfectly smooth and free from tangles it is also perfectly dry.



An electric comb for drying the hair quickly while removing the tangles after a shampoo



Weight the bulb with a small stone and lower it into the bottle; keep it in water and it will finally blossom as on the left

How Did the Crocus Grow in the Bottle?—A Trick for the Amateur Horticulturist

A CROCUS growing and blossoming inside a bottle? How did it get there? This is how the idea is carried out. Get a good sized bottle, the neck of which is just large enough to admit of the passage of a crocus bulb. Pour into the bottle about an inch of water. Tie a piece of string around the bulb, in the manner shown in the photograph. Loop the string around a stone in such a way that the stone is held at the bottom of the bulb. The stone should be a rather flat pebble on which the bulb will rest upright.

By means of the string, lower the bulb into the bottle. When the lower part of the bulb just touches the water, the string may be fastened around the neck of the bottle. The bottle should now be removed to some dark place for a few weeks, at the end of which time it will be seen that the bulb has sent out numerous roots. It may be needful to add a little fresh water now and again to keep the level up. Keep the bottle near a sunny window. After a time the bulb will begin to flower. Then the string may be loosened from the neck of the bottle and dropped down inside.

Handling Live Rattlers

How professional snake hunters manage the most venomous reptiles and extract their poison

By A. M. Jungmann

Keeper Charles Snyder, of the reptile house, Bronx Zoo, New York, extracting snake venom

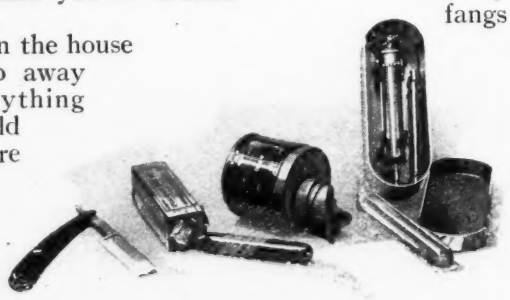
IF you are quick and fearless you may manage any snake so long as you are armed with a cane or a piece of wood like a cane. Push the snake around in any way that you can in order to prevent him from coiling. When you have him in just the right position, make a very quick move and place your cane across his neck, just behind his head. Then you have him. He cannot get out of control. Now bend down and grasp the snake in the place where your cane rests, just behind his head. With your left hand put his body under your right arm. No matter how enraged the reptile may be he can do no harm as long as you hold him in this position. His body is held by your arm against your side so he cannot coil around you or around any convenient object.

In handling snakes in the house it is essential to keep away from furniture or anything which the snake could coil about. They are very strong and once they get themselves wrapped around any object it is exceedingly difficult to pry them loose.

Pike county, Pennsylvania, is known for the number of rattlesnakes which infest certain parts of it. Men make a business of catching these dangerous snakes. They are sold alive to museums and to individuals for exhibition and other purposes. The snake hunters of Pike county employ the method described when catching the reptiles. They carry them home in sacks and store them away in a wooden bin. When the hunter desires to show one of his captives he reaches into the bin, dexterously whips out a rattler and throws him on the floor. Then he holds out an old hat to the angered snake and permits him to strike it repeatedly. By the time the snake has bitten the hat several times it has exhausted its supply of venom. But even then there would be enough venom left in the fangs to do harm. The hunter, however, feels that the chances are in his favor and does not hesitate to handle the snake freely.

When a poisonous snake wishes to bite, or strike, an enemy, it rears its head, lowers its under jaw and elevates its upper jaw in such a way that the fangs are directed straight forward. Then it strikes with incredible swiftness. When the fangs strike, the poison sacs are opened and the venom is injected into the victim as with a hypodermic syringe. The action of snake venom is very rapid. Small animals and birds fall to the ground immediately upon being struck. They become paralyzed and die in a few minutes.

Removal of the fangs does not make a snake safe to handle, because as soon as one set of fangs is removed others grow. They are supplied with two fangs in the upper jaw. Once in a great while, as in the case of the moccasin pictured on the following page, a snake may have three fangs, a new one having grown in before the old one fell out. Some snakes will inject as much as a teaspoonful of venom into an enemy.

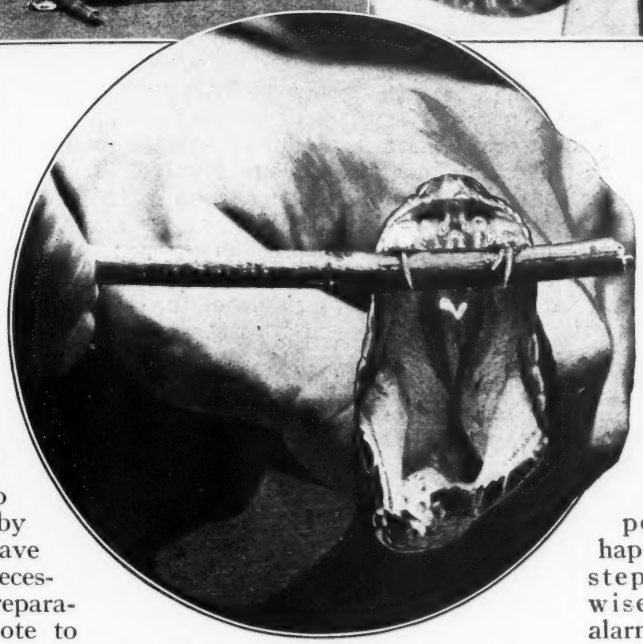


In case of snake-bite you would need a razor to open the wound, anti-venom serum, a syringe for injecting it and a rubber bandage

Poisonous snakes

With a quick movement place the cane across the neck of the snake just behind the head, then grasp him in the spot where the cane rests

When held in this way the snake is perfectly harmless. Care should always be taken not to give it a chance to coil around anything



The usual number of fangs is two, but sometimes a third one grows in before it is due

are captured in order to secure their venom for the preparation of anti-venom snake serum. This serum, if injected into a person who has been bitten by a snake, will save his life. The necessity of the preparation seems remote to us who live where venomous snakes are comparatively rare. But in some parts of the world snakes do much to keep the death rate high. In the Indian Peninsula, for example, the Cobra, the Krait and a few other venomous snakes cause the death of 25,000 persons every year. Fatalities from snake bites are numerous in Burma, Indo-China, Australia, the Dutch Indies, Africa, the West Indies and Tropical America.

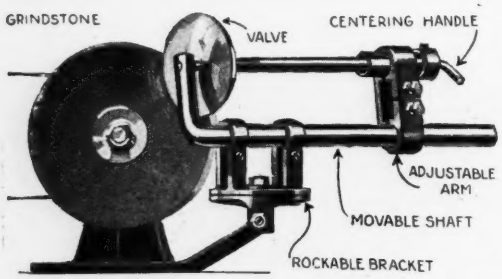
Treatment for snake-bite consists in immediately making a tourniquet some distance above the wound to prevent the blood from carrying the venom through the system, then making deep incisions in the wound with a razor or a sharp knife to permit it to bleed freely. Permanganate of potash should be sprinkled into the wound and then anti-venom snake serum should be administered. If these precautions are taken quickly the danger of the bite proving fatal is greatly lessened.

Ordinarily, however, even the most venomous of snakes will not harm a person unless it happens to be struck, stepped on or otherwise annoyed or alarmed. In this country snake-bite fatalities are rare.

Potash from Seaweed—An Industry in the Making

AN ambitious project to obtain potash from seaweed in the Sargasso Sea, in the North Atlantic Ocean, is planned by W. S. Warner, of Tampa, Florida. He intends to build a special vessel of reinforced concrete and equip it with machinery for hoisting the seaweed from the ocean and reducing it to ashes. After running the seaweed through three successive sets of heavy rolls to remove the water, it will be passed through rotary drying kilns, burned, and the ashes, in which the potash content is concentrated, stored in the hold of the vessel. Mr. Warner plans to install an equipment capable of producing two hundred tons of ashes per day. The Sargasso Sea is literally covered with seaweed.

Grind Your Valves at Home. A Machine Made for Car Owners



The valve head is held at an angle against the rotating grinding wheel which drags it around and bevels its edge into a perfect circle

AN automobile cannot work efficiently unless the engine-valves are in good condition. The valves control the supply and the exhaust of the vaporized gasoline in the engine cylinders, and if they should wear unevenly and begin to leak, the maximum amount of power cannot be obtained from the fuel. Hence the valves should be ground often.

A machine for grinding the engine valves accurately and rapidly has recently been invented. The valve-heads, which must be ground perfectly round so that they sit tight against the circular ports or openings in the cylinder, need only be adjusted in this machine, and the grinding will proceed automatically. Evidently such a machine would enable an autoist with average mechanical skill, to grind down the valves of his own car.

The illustration shows a valve-head adjusted in position in the machine. An emery grinding-wheel is rotated at the front end and the head itself is held in place by a holder at the other end. The holder can be moved lengthwise in its bearings, while the turn-table on which it is mounted allows it to be swung at an angle to the plane of the grinding wheel. The valve-head is pivoted between two steel points on the holder so that it can freely rotate on them.

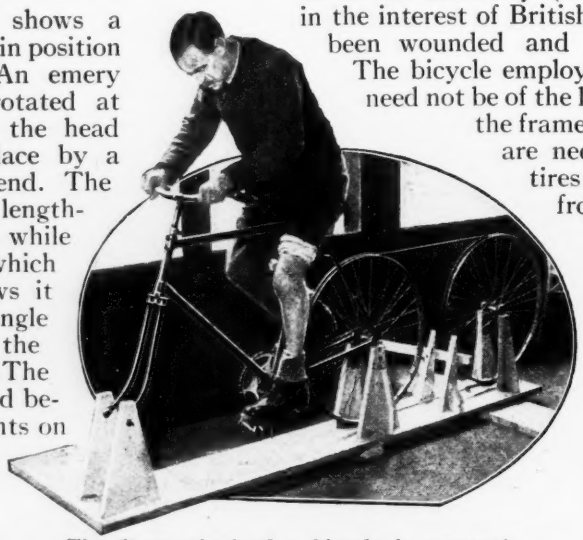
A small electric motor, which is geared to the grinding-wheel, is then turned on. The revolving wheel, with the edge of the valve-head in contact with it, drags the head continuously around. At the same time, the wheel continuously "strikes off" sidewise from the edge of the valve-head and consequently bevels it down. The valve-head rotates always a fixed distance from the plane of the grinding-wheel, so that a perfect circle will be obtained on the head.

A person of only ordinary skill can grind a valve with the machine described, on account of the fact that the valve is always in the proper position with relation to the grinding wheel. Any standard valve can be ground quickly and easily, as the only change in the machine's adjustment is to adapt it to a long stemmed valve or a short stemmed valve. This is done by changing the position of the arm on the shaft.

When valves having stems of about the same length are being ground it is not necessary to change the position of the arm, in view of the fact that the socket member is adjustably mounted in the arm.

The Bicycle to the Rescue in Leg Treatments

ONE of the simplest devices yet heard of for restoring strength and agility to soldiers' legs after they have recovered somewhat from the effects of wounds, is utilized at an electrical gymnasium which has been started at Chateau D'Oek, in Switzerland, by a French Adjutant and C. S. M. McCarty (Leicester Regiment), in the interest of British soldiers who have been wounded and are convalescent. The bicycle employed for the purpose need not be of the latest model. Only the frame and the two wheels are necessary. Not even tires are required. The front wheel is taken off and the frame is fastened to a stationary support. The wheels are arranged at the rear as shown in the accompanying illustration. The tires are removed and a belt or rope supporting a weight is carried over the wheels.



The front wheel of a bicycle is removed, placed in the rear, belted up with the other and an exerciser for leg muscles is made

Why Navies Have Small Armored Cruisers

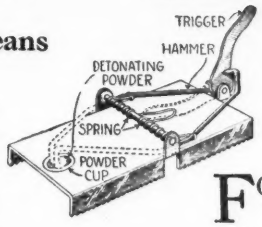
ARMORED cruisers are fast vessels of from eight to fourteen thousand tons in displacement, which have their vitals, such as guns and machinery, protected by armor plate. They do not carry as heavy guns as battleships, and are supposed to have greater speed. There seems to be a cessation of building of this particular type of vessel in recent years, the main dependence in fighting being placed in dreadnoughts, battle cruisers, destroyers and submarines.

Some few scout cruisers are being built by the naval powers. These, as their name indicates, are fast, lightly-constructed cruisers of from five to seven thousand tons displacement, possessing the highest speed attainable for vessels of their size, great cruising radius, and armed with guns of comparatively small caliber. They are used to locate the enemy and are known as the eyes of the fleet.

The trigger of the burglar trap is so delicately adjusted that the slightest movement of the door will operate it

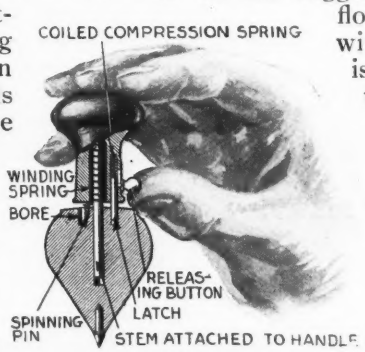
Spinning a Top by Means of a Spring

A DEVICE for spinning a top in a brand-new way has been invented by George John, of Detroit, Michigan. It operates by a spring, which gives the top its whirling motion as it rapidly unwinds.



As the illustration shows, the spring is fitted around a short wooden stem attached in the center of a wooden knob. This stem protrudes beyond the end of the knob so that it may fit into a corresponding hole bored in the center of the top itself.

When the stem is placed in the hole and the knob is turned, the bottom end of the resilient spring is caught by a projection upon the top and the spring winds up. The smaller stem in the knob is then pushed down into one of the several holes bored into the top, to hold it in position. The top is aimed and this stem pushed up. The compressed spring then pushes the top away from the knob while it unwinds. It spins rapidly and with a loud hum.



A wound-up spring in the handle of the top starts the spinning

Defending the Home with a Mousetrap Gun

FOR protecting the home against burglars, Daniel Cruice, of New York, offers us the home defence "gun," shown in the accompanying illustration. The "gun" uses real gunpowder—not to shoot the offending burglar, but to awaken the sleeping household.

The contrivance is set by drawing back the skeleton hammer against the tension of its spring and by catching the hammer in the trigger. It is then placed on the floor with its trigger in contact with the door. When the door is opened, the trigger is hit, the hammer tripped, and the detonating powder fired. No burglar would dare enter after such a noise. Toothed edges prevent the "gun" from slipping back when the door strikes it. Of course the device should not be set until all the members of the household are safely in for the night.

Bathing in Melted Wax

If your joints are stiff, boiling wax poured over them may bring relief

By the Paris correspondent of the Popular Science Monthly

Photos by Boyer

Pouring hot paraffin wax over a patient. Note how the wax forms a kind of plaster cast over the legs as soon as applied

At left: The cradle for the partial bath. In this instance the patient's arm alone was coated with wax from elbow to fingertips

THE wax bath is a new idea in medicine and is recommended as a curative measure in a number of ailments, such as rheumatism, various disturbances resulting in skin troubles, inflamed and painful joints, and so forth. Incredible as it may seem, it is possible to pour boiling wax on any part of the human body without causing burns.

The treatment originated with Doctor Barthe de Sandfort of France, who found the wax bath very successful in a number of stubborn cases. The wax he uses is a paraffin composition prepared after his own formula and possesses curative properties which would not be possessed by the ordinary wax candle.

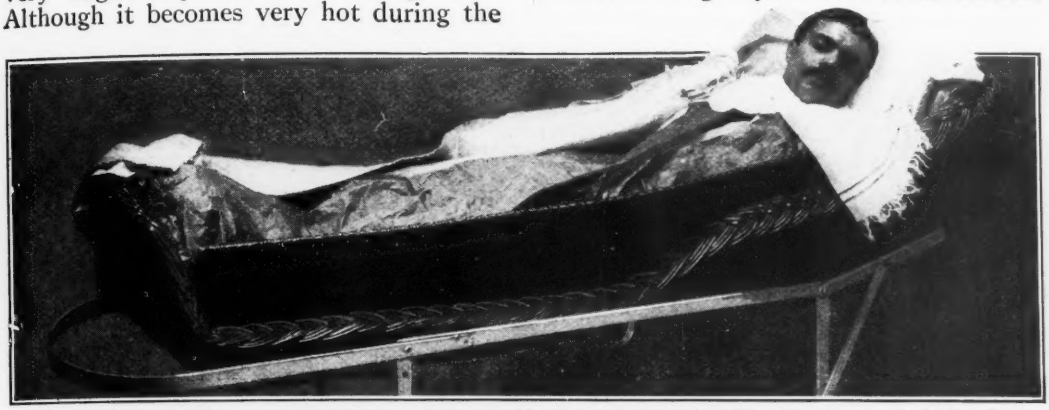
The patient who is to receive a paraffin wax bath is placed in a wicker basket so built that his head is slightly raised. The basket is lined with a material impervious to wax. When all is ready the hot wax is poured over the patient so that his entire body is coated with it, or the part which is to be specially treated. When the wax cools, the patient looks as if he were covered with a plaster cast. After the wax has been poured on, the patient is covered carefully with a quilt, and remains in his wax bath just as long as the physician deems it necessary to bring about relief.

When a patient is taking an entire wax bath, which means when he is covered with hot wax from his chin to his toes, the wax is not quite as hot as when a patient is taking what might be termed a partial bath. That is to say, if a patient is suffering from, say rheumatism in his elbow, he can stand the wax at a slightly higher temperature than he could were it poured all over him, for the simple reason that the skin over the elbow joint is not so sensitive as that of other portions of the body. Doctor Barthe de Sandfort has devised a method for heating his paraffin so that the composition is not altered. The temperature may be varied in greater or less degree, and large or small quantities of paraffin may be heated as it is required for use. The paraffin is heated by steam which is regulated by valves.

After the patient has been in the bath for about eight minutes his forehead will be covered with a slight moisture and his respiration will become accelerated. After a time, varying from fifteen to thirty minutes, the wax is removed from the entire body and the invalid then lies down and rests.

The fact that he is not burned always causes the patient a great deal of astonishment. The real reason is that wax has a very slight capacity for holding heat. Although it becomes very hot during the melting process it loses its heat almost immediately upon being removed from the flame or from over the steam. Consequently, although it is boiling hot when it leaves the spout, and is still hot enough to be poured when it reaches the body, it is not sufficiently hot at the moment of contact with the flesh to burn it.

This new wax cure has been recommended as a means of aiding soldiers to recover the use of joints which have been stiffened through injuries received in the war.



A patient completely immersed in a wax bath from chin to heels. The basket couch is lined with a material impervious to wax. In this he lies, perspiring freely, for a specified time

A Perfume Spray from a Penny Slot Machine

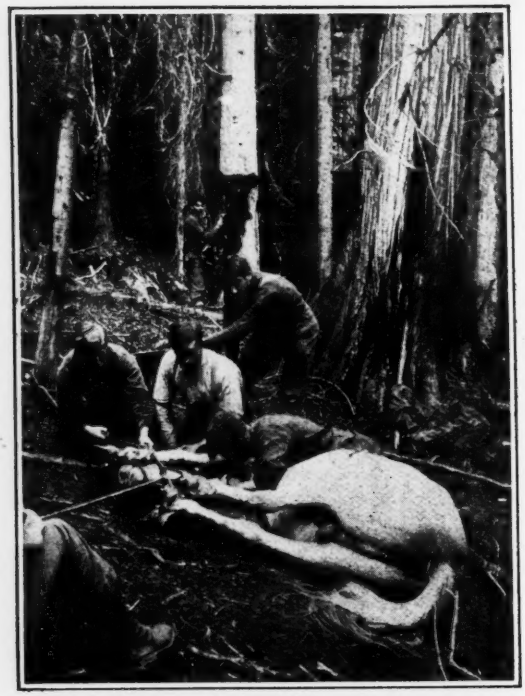
A NEW slot machine has made a bid for popularity on some of our street corners and railway stations. For only one penny deposited in the slot you can spray your clothing or your pocket handkerchief with perfume of any preferred odor. The mechanism is simple. After dropping the coin in the slot, you press a lever in the usual way. This operates a bellows, forcing air through the perfume container and producing the spray. The weight of the coin passing down through the chute, overbalances a latching device and moves it away from the lever, while a movable arm drops to allow the bellows to operate.

It may be true that those who delight in the perfume of the heliotrope, the violet and the rose, and who occasionally neglect to provide for their olfactory satisfaction before leaving home, may bless the machine; but there are those to whom the thought of a dozen different perfumes mingled with the stagnant air of a crowded car is anything but pleasant. However, the amount obtainable for the penny inserted in the slot is not likely to be sufficient to be objectionable.

Why Does Oil Poured on the Waters Calm the Sea?

WAVES in mid-ocean are caused entirely by the action of the wind. The adhesion between the rapidly moving particles of air which compose the wind and the surface particles of the water causes the water's surface to be dragged along with the air. Small ripples are immediately formed. These ripples soon overtake others near them. They unite, and due to the friction between the water particles, each succeeding ripple piles up on the top of previous ones.

Just as soon as oil is spread upon the water, however, the size of the waves is reduced like magic. The reason for this is interesting. Oil, unlike water, has very little internal friction between its particles. The ripples of oil formed by the wind, therefore, cannot pile upon each other to any considerable height. Hence, water waves cannot grow in an area of oil placed about a steamer. They begin to fall down instead. By the time these waves reach the boat they will have lost their formative ripples and the result is a perfectly calm surface over the portion of the sea through which the boat is making its way.



It took five men to throw Moses to the ground, "hog tie" him and then shoe him properly

Moses Didn't Want to be Shod. So They "Hog-Tied" Him

WHEN forest rangers and government engineers are in the field many miles away from the nearest town, they frequently have to do their own horseshoeing. This is a comparatively easy task if the animal is tractable and accustomed to the operation. But often the men have to "hog-tie" their horses—that is, throw them to the ground and tie their feet together. To throw a horse to the ground without injuring him is no tenderfoot's job. It requires much patience and muscular power.

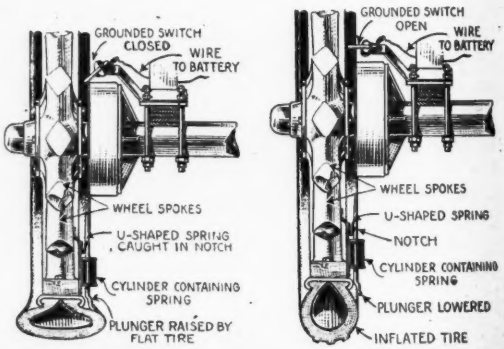
The horse shown in the illustration is Moses, one of the animals attached to a topographical engineering party in Oregon. Moses wouldn't stand and allow his captors to shoe him. Consequently he was forced to submit to all the indignities of the hog-tie. Three men are holding his feet by ropes, one is holding his head and the other, leaning over him, is doing the shoeing under difficulties. The sixth man in the party has a cub bear skin which he is tacking to a dead tree. When the men have finished shoeing Moses they will roll him over so that he will be on the down-hill side. This is the only position in which he can regain his newly-shod feet without considerable danger of hurting himself.

An Alarm That Warns You of a Leaking Tire

IT frequently happens that air leaks slowly from a tire without the driver's knowing it. The tire becomes flat and the rims of the wheel cut into it. To warn drivers in time, George F. Young, of Indianapolis, Indiana, has invented an electric alarm which can be attached to any wheel. It consists of an electric switch which is mounted on the axle of a wheel. The blade of this switch projects toward the spokes of the wheel. The end of the blade stops very close to the spokes, though enough space is left to enable the blade to barely clear them.

Working in conjunction with the blade of the switch is a metal finger mounted on one of the spokes of the wheel. This finger can slide radially to the wheel, but a spring normally holds it away from the axle, with one end up against the underside of the inflated tire. The other end of the finger will clear the projecting blade when the tire is properly inflated. Just as soon as the tire begins to flatten, the finger is pressed radially inward and it strikes against the projecting blade. The switch is thereby closed, and an alarm, such as a well located light or a buzzer which is very easily heard, is operated.

The various switches are mounted so that they do not rotate with the wheels with which they are associated; but they are placed in a position so that they will be thrown to one or the other of their closed positions when the tire is punctured or if the air suddenly leaves it. This method of mounting may be carried out in several different forms. The one most convenient is shown in the accompanying illustration.



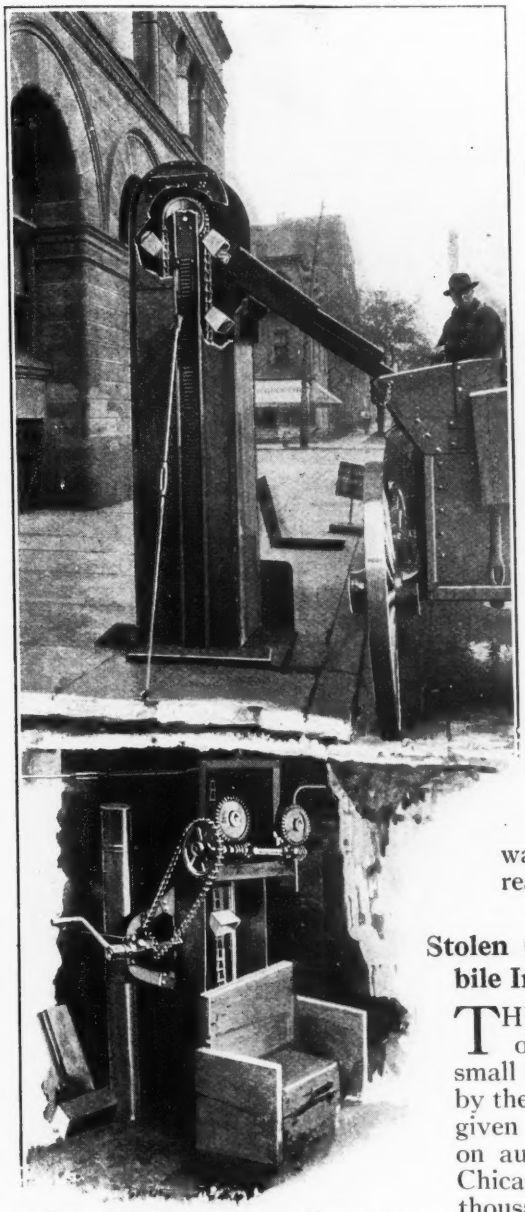
A flattened tire presses a switch-finger inward. The electric switch is thus closed, and an alarm in the circuit at once gives warning

Loading Ashes Automatically

The endless belt conveyor saves the janitor's back and the landlord's money

THE endless belt has been found to be a solution of a wide variety of problems. It is even being used now as a conveyor of ashes from large buildings. Thus applied, it far outstrips the older methods of carting up the ashes from the boiler-room by the barrel. Instead, it brings them up and discharges them in one continuous stream directly into waiting wagons. The conveyor for this purpose must be portable; it must be one which can be raised into position when in use, and lowered below the level of the sidewalk immediately afterward. This is because no obstruction can be allowed for any length of time above the sidewalk on any city street.

To accomplish the raising and lowering, the conveyor is enclosed in a casing of sheet iron. Two flat rack gears are attached to the casing, one on each side. In these, two pinion gears mesh, and when these pinions are turned by the hand-crank with which they connect, the casing, belt conveyor and all are moved in the direction desired. Hence, when the ashes collected in the engine-room are to be removed, the conveyor is first lifted from its casing in the ground, up through its trap-door, and stationed on the sidewalk. The ashes are then shoveled into a suitable pit built in the engine-room floor, and the belt is started going by the small electric motor geared to it. The buckets on the belt dig into the pile of ashes as they pass through the pit. They are filled automatically and travel upwards to the surface. On reaching the belt-sprocket at the top of the conveyor, the buckets swing around with sufficient speed to throw the ashes off into the sloping chute at the side. From here they slide into a waiting wagon, and are ready to be carted away.



The buckets on the revolving endless belt dig into the piled ashes and carry them up to the street where they are dumped into wagons

Stolen Cars Send Automobile Insurance Rates Up

THE increasing number of stolen cars and the small proportion recovered by the police are the reasons given for the raised rates on automobile insurance in Chicago. More than four thousand cars were stolen in that city during the first nine months of last year. The advanced rates on cars valued at less than $700 are from twenty-five cents on new cars to $2.25. On 1915 models the advances are from fifty cents to two dollars, and on the 1914 models from fifty cents to one dollar.

A Crib, Baby-Carriage and Bassinet All in One

A STRANGE new vehicle has been invented for the comfort and convenience of babies and their mothers. It is a combination crib, baby carriage and bassinet so arranged that it can be folded away and stored in small space when not in use.

The crib is enclosed in a silver-wire screen and is provided with a sheltering canopy to keep away flies. A mattress-platform is provided in order to make the crib a downy bed for the youngster. When the infant's nap is finished, the mattress and board can be lowered. This leaves a roomy little play-space where the baby may romp and exercise without the slightest possibility of injury to himself. His mother knows he is safe and can go about her usual duties.

Above: The crib extended, with its sheltering canopy in place. At left it is being folded for storing away

Saved by a Tin Filled with Soup Cubes

A PRIVATE in the Gordon Highlanders owes his life to a can containing soup cubes. The illustration strikingly shows what happened to the bullet intended for him. Here is the private's own story:

"I had just received my weekly parcel from home on the 24th of September, as we made the charge at Loos on the 25th, so I thought I would put my cubes in my pocket as when I got them the week before I lost them out of the parcel.

"We went over the parapet on the Saturday morning, and drove the enemy right out of Loos and over Hill 70. All at once I got a bullet in the leg, and about five minutes after I felt a sharp prick in my right side—a bullet had gone through my cubes. Had not the cubes been there, I would have lost my life, as the bullet would have gone in my right side and out at the left. Please be sure to send my lid to my house when you have done with it, as I would not part with it for anything."

A private in the Gordon Highlanders was saved from death by a can of soup cubes. A bullet passed right through the can

We have heard of cases of a much-treasured Bible, carried above a soldier's heart in obedience to a mother's request, saving his life, but never before has a prosaic soup cube had such a romantic mission.

Marks of Age by Which Dressed Poultry May Be Tested

THERE are tricks in every trade, they say, and the average poultry dealer is not likely to be altogether exempt from the implication; for there are almost no tests by which the buying public may judge the age of his birds which he may not, if he is so disposed, cover up or offset. For instance, it is commonly known that in a young chicken, goose or turkey the end of the breastbone is easily bent, like the cartilage in the human ear, while in the old bird it is brittle. But this test is often rendered worthless by the dealer breaking the end of the breastbone so that it seems pliable.

The feet sometimes furnish a clue. In a young bird they are soft and smooth, while in an old one they are hard and rough, and if a male the spurs are long and large. Young turkeys have black feet, it is said, which grow pinkish at about three years and then turn gray and dull. In ducks and geese the flexibility of the windpipe denotes the age.

The Acetylene Life-Preserver. It Blows Itself Up with Gas

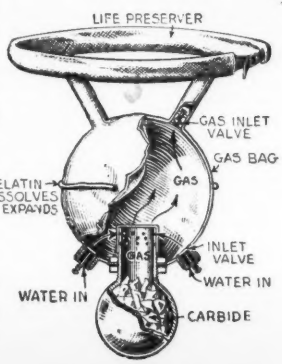
VERY efficient is the life-preserver pictured in the illustration below. All that it asks of the person to be saved is that it be strapped securely around his body. It will do the rest. As soon as it strikes the water it will inflate itself with gas and will become so buoyant that it will keep its wearer afloat until he is rescued. Kurt Nebel, of Chicago, Ill., is the inventor.

An inflatable tube lies flat against the body when fastened around it. To this tube is attached a gas bag, with a container for carbide at its lower end. The gas bag is also provided with inlet-valves through which the water enters, finding its way eventually to the carbide and generating gas instantly from the contact. This gas rises and fills the tube around the wearer's body.

Before the gas bag is inflated it is held flat by a gelatin cord which is looped around its center and which dissolves when immersed in water, so that the bag can round out. This distension, together with the pressure of the water on the outside, tends to open the inlet valves so that the water may find entrance to the carbide. The device is also used as a buoy for those learning to swim.

If thrown out into the water to a "man overboard," the water will dissolve the gelatin cord and the gas bag will become inflated just as previously described, so that all the person to whom it is thrown will have to do will be to slip his head and shoulders through it and adjust the strap to fit snugly around his body.

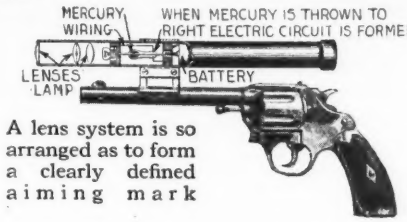
The device will continue to generate its own gas for an indefinite length of time. The wearer's movements are unimpeded by it.



Above: The acetylene life-preserver in operation. It will keep the wearer afloat for an indefinite length of time

At left: Device in detail. When water makes its way into the gas bag it generates sufficient gas to inflate the tube

An upward snap of the muzzle of the revolver closes the circuit which lights the lamp



A lens system is so arranged as to form a clearly defined aiming mark

A New Flash-Light for the Gun

MANY and astonishing are the variations of the schemes to attach a flash-lamp to a firearm and so make shooting in the dark as nearly infallible as possible.

The latest improvement in that line is a self-lighting lamp attached to a pistol, the light staying out until the pistol is leveled at the mark, then lighting automatically.

The lamp circuit is completed by a tube of mercury and air, with the mercury so arranged in conjunction with the air that it will move readily. A quick upward snap of the muzzle of the gun moves the mercury in the tube, closing the circuit and lighting the lamp. A downward snap of the muzzle of the gun drives the mercury forward and breaks the circuit again. A lens system in the lamp is so arranged as to form a clear and easily defined aiming mark, which is readily adjustable.

© Brown & Dawson

Madeira's winter sport in summer time—sliding down a mountain on a wicker-chair sled

Sliding Down a Mountain on a Summer Sled

INSTEAD of wheeling you down the mountains of Madeira, as you might suppose, the hardy natives slide you down. You seat yourself in a comfortable wicker chair mounted on a wooden sled fitted with steel runners and come down the rocky path of the mountain side as if you were sliding on snow. The human locomotive in the rear steers you down the mountain and pulls the empty basket-cars up again.

The Only Railroad on the Seward Peninsula, Alaska, is a "Pupmobile"

THE "pupmobile" is a passenger train drawn over a regular railroad track by dog-power. The one shown in the photograph is the only one in existence. It carries passengers from Nome, Alaska, across the level land near that town into the mountains.

The track is a narrow-gage railroad built in 1900. A high tax was placed on railroads in Alaska soon after that, and as there was not enough traffic over the road to justify the expense of operating locomotives, the regular train service was discontinued. Then the "pupmobile" was instituted. The accommodation for passengers consists of a platform on which are two seats. To this from seven to fifteen dogs are harnessed, and the rate at which they travel compares favorably with much of our "rapid transit." Furthermore, it is about the cheapest railroad to operate that we know of. Six pounds of dog meat a day is considered to be a fair expenditure of "fuel."

From seven to fifteen dogs draw the two-seated passenger car over a narrow-gage track at "rapid transit" speed

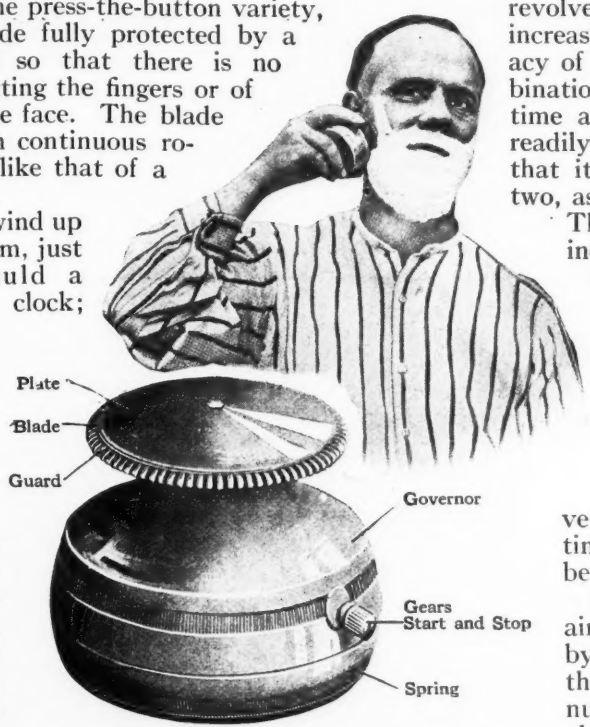
Rag-Time Music as an Adjunct to the Operating Table

EVEN surgeons have a sense of humor. A patient was rushed to the Columbus Hospital of Chicago, not long ago, in a critical condition. The excitement of getting him there so jarred on his nerves that when it came to administering the anesthetic, he refused absolutely to accept it. After every augument failed, the surgeons thought of trying to soothe him by playing a phonograph that was in the building. When finally a popular air was put on, the patient began to see the humor of the situation, and without further trouble he took the anesthetic. His appendix could then be removed without further musical accompaniment.

Shave Yourself with a Buzz Saw—That's the Newest in Razors

HERE is the most decided departure from the ordinary safety razor which we have seen. It is a compact little contrivance of the press-the-button variety, with the blade fully protected by a safety guard so that there is no danger of cutting the fingers or of scratching the face. The blade operates with continuous rotary motion like that of a circular saw.

First you wind up the mechanism, just as you would a watch or a clock; then you apply it to your well-lathered face and press the button at the side. According to the inventor, C. B. Collins, of Des Moines, Iowa, you should have a perfectly beautiful shave without a scratch or the slightest abrasion of the skin, in almost less time than it takes to tell it and without a particle of annoyance from dull blades.



Press the button at the side of the razor, and Presto! You have a perfect shave

The club makes an extension barrel for the revolver giving it greater range

How a Policeman Can Use His Club to Change His Pistol into a Rifle

THE ordinary hardwood club which the policeman swings so jauntily as he makes his rounds, looks formidable enough to the wrong-doer. But it may prove to be even more deadly than it looks. Sheriff Frank Barnet, of Oakland, California, has devised a plan for combining the club and revolver in one weapon, thus increasing the range and accuracy of the revolver. The combination is made in a moment's time and may be unlocked as readily as it is put together, so that it is either one article or two, as desired.

The sheriff's club is fourteen inches long and through its center a hole is bored for a barrel. This is made to join the barrel of the revolver by means of a special locking device. With its additional fourteen inches of barrel the revolver is thus converted into a rifle with three times the range which it had before.

It is also claimed that the aim is so much improved by this arrangement that the burglar or other human nuisance has absolutely no chance to get away after he has been sighted.

The club is not materially altered in weight by the boring away of a portion of its central interior, so that it can still perform effectual service in its own way.

At Last! An Automatic Motor-Driven Tire Pump

SCREWED into the compression-cock of an automobile-motor, the novel airpump for pneumatic tires shown in the accompanying drawing is distinguished by the use of a differential piston and a spring-operated diaphragm in which the tension of the spring controls the pressure of the air pumped into the tires by means of an external notched dial.

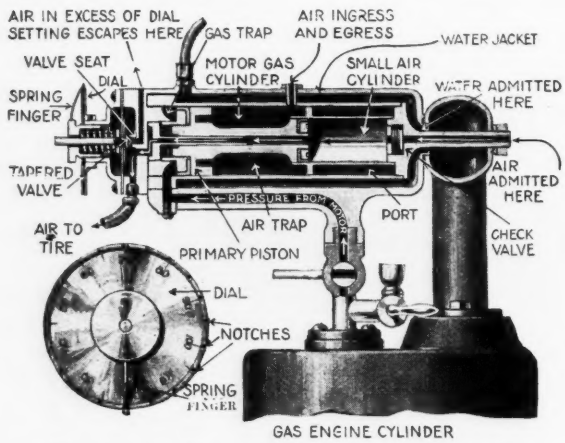


Diagram of the automatic motor-driven tire pump. The tension of the spring controls the pressure of the air by means of an external dial

The pumping of the air is effected through the use of two cylinders, one large and one small. The larger is open to the gases of the engine, while the smaller is open to the atmosphere at one end.

The differential piston, working in the two cylinders, is carried on a hollow piston-rod. As the piston is moved in one direction by the suction of the engine, air is sucked into the small cylinder through a check-valve.

On the compression or explosion stroke of the engine, the large piston is forced in the opposite direction, and the air is forced into the small cylinder because the check-valve is closed, then through the hollow piston-rod to the chamber controlled by the diaphragm under spring tension and thence to the tire in a tube.

Both large and small cylinders are water cooled from the engine system. The use of the differential piston on the hollow rod permits the air to reach the tire without becoming impregnated with any oil from the engine-cylinder. The pump is operated through a valve in the compression-cock nipple, which valve can be turned on or off from the driver's seat by means of rod connections. Air pumped by the device after the pressure at which the diaphragm has been set is reached, is passed off into the atmosphere, as indicated in the accompanying illustration.

In this way all the strenuous labor accompanying the pumping up of the automobile tire is done away with.

A New Safety Pocket-Book Is Combined with the Garter

A PICKPOCKET would have no chance of getting possession of the contents of the pocket-book illustrated, without a strenuous tussle with the wearer. The best of it is that no thief would be likely to suspect the existence of such a pocket.

Made as part of the garter, it is fastened under the front pad and made to extend down into the sock, as shown. There is a flap which fastens with a glove button arrangement to the outer part of the garter. The pressure of the elastic band serves to make the closing still more secure.

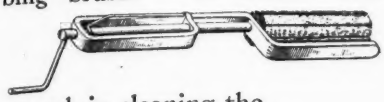
The pocket is attached to the rear face of the garter and extends down into the sock

The pocket-book is thus concealed inside the sock and is made to lie flat against the leg so that there is no discomfort. If through careless fastening or other negligence, the clasp should come open while the garter is in use, the purse would slip down into the sock and would be immediately felt, so that there would be no possible chance for it to be lost without the owner's being aware of it.

It is the invention of Edward V. Crouse, of Chicago, Ill.

Giving the Teeth a Clean Sweep with a Rotary Tooth-Brush

PRACTICALLY, the tooth-brush is a miniature scrubbing brush. It works well



enough in cleaning the surfaces of the teeth. But in cleaning the spaces between them—the very parts that need cleaning most—it is deficient. Food will collect between the teeth before it will collect anywhere else. If not removed it starts to decay.

A rotary tooth-brush has been invented, which cleans out the crevices between the teeth as well as the tooth surfaces. The brush is guided with one hand and turned with the other. The metal guard prevents the bristles from touching the inside of the mouth. The turning bristles rotate parallel to the crevices, some scrubbing the surfaces of the teeth and others penetrating into the crevices.

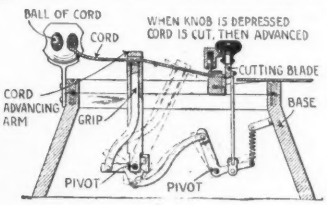
When the handle of the brush is rotated certain bristles scrub the surface while others penetrate and clean the crevices

Do You Know That We Americans Have Over a Hundred Volcanoes

MORE than a quarter of the active volcanoes of the world are on United States soil. We have the distinction of possessing about sixty volcanoes in Alaska and in the Aleutian Islands just off the coast. In the western United States, in the Philippines and in the Hawaiian Islands we have nearly as many more, making over a hundred volcanoes that we possess (not that we place any value upon their possession). There are but four hundred and seventeen throughout the entire globe.

A Machine Which Automatically Feeds Twine and Cuts It

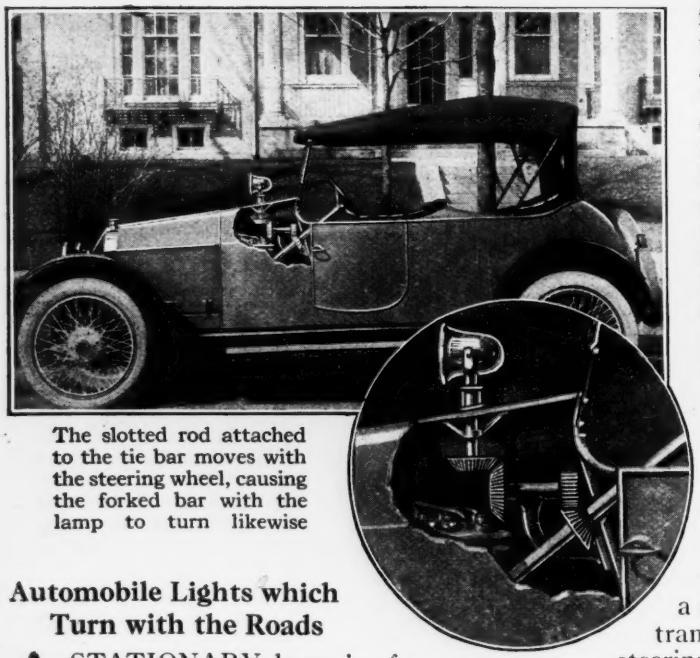
THE wrapping clerk who has learned the trick of breaking twine only after his fingers have suffered from cuts and burns, will welcome the appearance of a machine which will not only cut twine at the point desired, but which will feed it along under a cutter so that the end is always within convenient reach. The machine does its work with the faithfulness of a human; there is no need for the operator to watch it as he wraps his bundles.



You punch the knob, and the blade cuts the twine and more is pulled out

The twine is cut by pressing down a knob which operates the cutting blade. At the same time the twine is advanced by an arm which moves forward when the knob descends. In this way the twine is fed forward as fast as the knob is operated, leaving, with each stroke of the knife, a slight length on the side of the machine nearest the wrapper to be used for the next package.

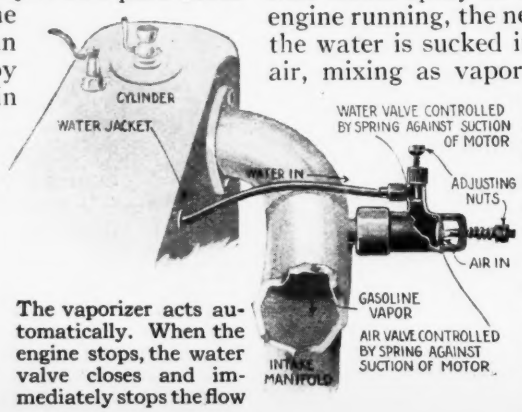
The twine is held in a cup large enough to accommodate several sizes. It makes no difference how thick or strong the twine may be, the machine will cut and feed it along as fast as the operator works.



The slotted rod attached to the tie bar moves with the steering wheel, causing the forked bar with the lamp to turn likewise

Automobile Lights which Turn with the Roads

A STATIONARY lamp is of no value in lighting up the road when turning a corner or curve; but a searchlight mounted on top of the motor hood may be turned directly on the path to the right or left as the steering wheel is turned, the movement of the lamp being accomplished by a train of gears between the steering wheel column and the lamp support. The latter consists of a forked rod which extends down through the motor hood in a vertical sleeve supported by a small bracket riveted to the underside. A bevel gear is carried on the bottom of the forked rod. This gear in turn meshes with another bevel on a short horizontal shaft supported by a second bracket bolted to the forward side of the dashboard. The rear end of this shaft carries a pinion which in turn meshes with a split two-part bevel gear slipped over the steering wheel column and adjusted to fit by means of small bolts in the gear collar. In another device for accomplishing the same purpose the ordinary headlights as carried in front of the radiator are made to turn to the right or left as the wheels are turned, the movement of the former being accomplished through a system of levers attached to the tie bar between the steering knuckles of the front wheels. Each lamp is carried on a vertical forked rod. This rod has a cone-shaped sleeve fixed to it at about its midpoint which fits into an annular or ring-like end of a lever pivoted sideways onto the vehicle frame or a suitable bracket. The vertical rod carrying the lamp is turned in the ring-like support by means of a horizontal arm attached at its bottom. This arm is moved to right or left by means of a vertical sliding yoke bar, the bottom end of which is restrained to move in a slot in a plate bolted to the transverse tie rod between the steering arms of the front wheels.



The vaporizer acts automatically. When the engine stops, the water valve closes and immediately stops the flow

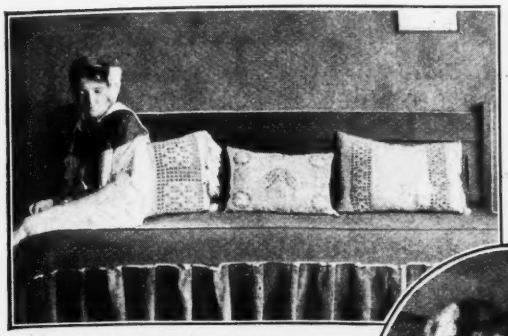
Removing Carbon from Your Automobile Engine with Water

L. E. SMITH, of Seattle, has invented a device which carries water from the jacket or circulation system of an automobile by means of a small tube and forces it into the manifold in the form of spray, thus acting as a complete decarbonizer and at the same time giving extra power to the engine.

From a tube fastened to the jacket the water flows into the device through a needle-valve which regulates the quantity according to requirements. The water vaporizer is tapped to the manifold, and an air valve at the other end supplies the force that forms spray of the water. With the engine running, the needle-valve opens and the water is sucked into the port with the air, mixing as vapor with the gas of the manifold intake. The action of the vaporizer is entirely automatic. When the engine stops the valve closes.

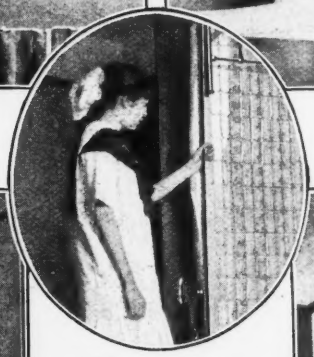
Water is a good decarbonizer. Hence this device not only removes the carbon but prevents carbon from forming.

Disappearing Beds of the Modern Apartments



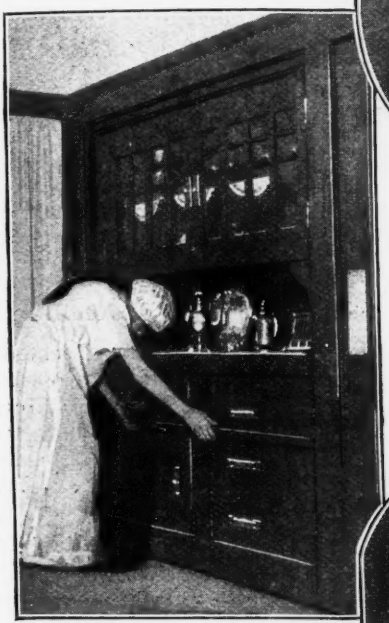
The type of bed which is a commodious couch by day is a wellknown popular favorite

She will fold over the head and foot of the bed and then tilt it up against the wall



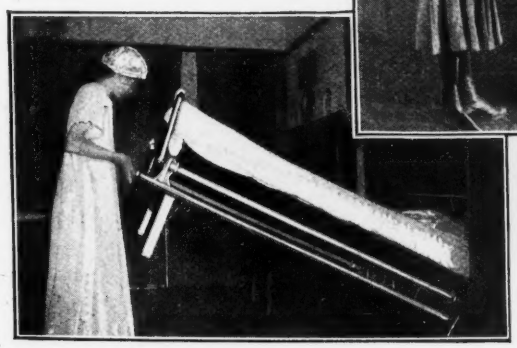
This wall bed slides into a narrow recess and leaves no trace of its existence

Below: A puritanically sedate corner where only books are seen by day

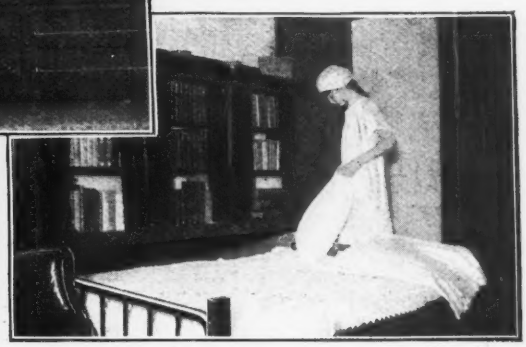


Sometimes the occupants of the tiny apartments sleep in their buffets, when they are made like the one above

The wall bed in position for the day. The bottom of the bed is a mirror set in a panel matching the woodwork



The buffet-bed pulled out, end first, converts the diningroom or even the pantry into a bedroom at a moment's notice



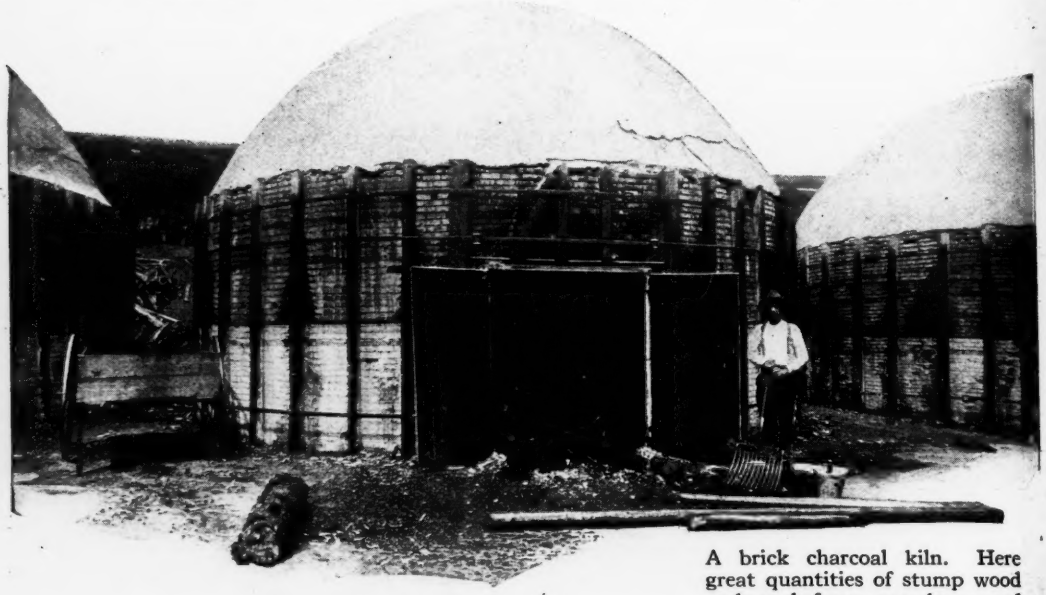
The bookcase corner transformed. A hinged panel at the lower end was let down and a bed was rolled out of the recess

War Time Uses of Wood

Great guns are fired with chemically transformed wood, and whole nations are kept alive by it

By A. W. Schorger

Chemist in Forest Products, Forest Products Laboratory, Madison, Wisconsin



A brick charcoal kiln. Here great quantities of stump wood and wood of poorer grade are used

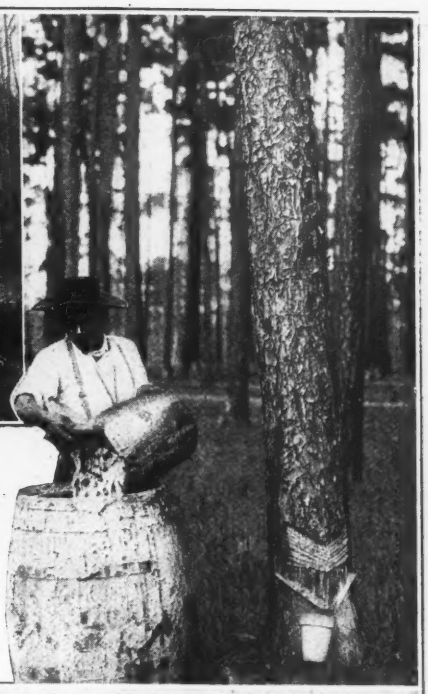
ONE of the mysteries of the present war is the source from which Germany obtains the gun cotton used in the manufacture of smokeless powder. A well-defined belief exists in England that at least part of the nitrocellulose (gun cotton) needed by German powder factories is being made from wood.

When England declared cotton contraband of war, it was maintained by many that Germany would not be greatly inconvenienced, since she was already making explosives from wood cellulose. The discussions that followed even developed the silly suggestion that the forests of Germany be destroyed by an enormous fleet of aeroplanes armed with bombs. One English editor dryly remarked: "This would scarcely be feasible since about one-third of Germany is forested."

It is an interesting fact that the first successful smokeless powder was made from wood, about 1865. This powder, invented by Schultze, consists of a mixture of saltpeter and nitrated purified wood. While inferior to gun cotton in power, it still retains high favor among sportsmen. Various other explosives, known as "white powder," "yellow shooting powder," and "Bautzen blasting powder" are transformations of wood.

The propellant explosive used in both large caliber guns and small arms is some form of nitro-cellulose or nitro-glycerine. On the caliber of the gun depends the size of the grain required; for the powder must burn uniformly and not too fast. Grains of any desired size may be obtained by mechanical processes, provided the original structure of the nitrated fibers has been destroyed so that they are reduced to a gelatinous mass. Thus the successful use of nitrocellulose powders depends upon the possession of proper solvents.

In the production of solvents the destructive distillation of hardwoods plays a highly important part. It yields methyl alcohol and acetic acid. From the latter is made acetone. The lower cellulose nitrates are soluble in a mixture of alcohol and ether, but when the nitrogen content reaches about thirteen per cent they are insoluble in this mixture but are soluble in acetone. It requires from seventy-five to one hundred



Above: Gun stocks in the rough. Walnut "flitches," from American forests, drying before being converted into weapons for the European armies

At right: Collecting the "crude" rosin from which our turpentine, pine tar and similar products are made, for home commercial use and for exportation

Kegs of rosin ready for shipment. Prices now paid for rosin in Europe are almost fabulous on account of its scarcity. It is used in making shrapnel, cheap soaps, and as a size for paper

tons of wood to produce one ton of acetone. Since all the acetone employed as a solvent is obtained from acetic acid, enormous quantities of wood are demanded for the supply of the solvents used in ammunition manufacture.

The quantities of alcohol and ether used for solvents for cellulose nitrates far surpass the consumption of acetone. Since ether is made from alcohol the raw material for its production is of great importance.

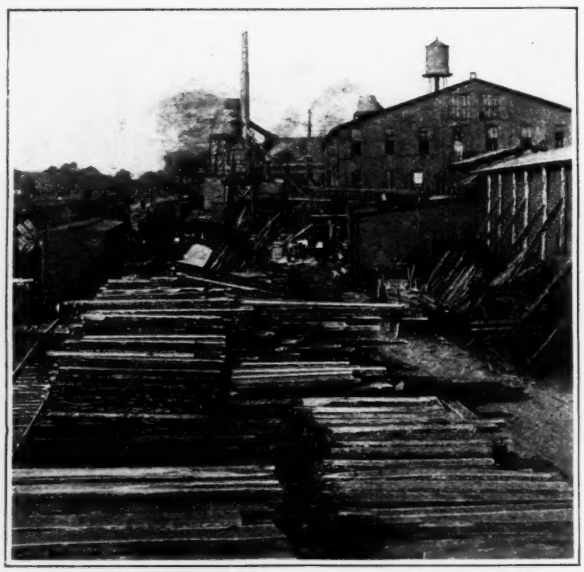
It is estimated that during the present year 40,000,000 gallons of denatured alcohol will be used at home while huge quantities

are being exported. In case of war, fortunately, our forests would be able to furnish the raw material for unlimited supplies of alcohol. The cellulose of the wood when treated with acids gives considerable quantities of glucose which can be readily fermented to alcohol. Experiments conducted by the Forest Service have shown that twenty-five gallons of grain alcohol can be obtained from one ton of sawdust, and it is probable that this yield can be still further increased.

But wood has other military uses besides that of furnishing raw material for explosives. Millions of gunstocks are made from American walnut, which is the best wood yet found for the purpose.

The Germans Brought Sawmills with Them Into France

With characteristic foresight the Germans brought portable sawmills with them into France, and have utilized their enemy's forests to supply their need for timber at the front, while reserving their own forests for home demand. The development of trench warfare, when vast armies of men dig themselves in on fronts hundreds of miles long, calls for an amount of timber for trench walls, floors, and braces that it is difficult to estimate. Millions of feet of lumber are required also for temporary buildings behind the fighting line and for housing noncombatants made homeless by the fortunes of war. Still more goes into bridges, wharves, and the like. High explosives have made it possible for a retreating army to destroy stone and steel structures behind them in short order, and such structures the pursuing army must have the means of quickly rebuilding. Wood is, in most cases, the only material that will answer the purpose. It served the German army in good stead recently during the pursuit of the Russians through Poland.



A portable saw-mill brought by the Germans into France so that the enemy's forests could be utilized

Turning from the materials needed for actual fighting to the no less important ones required for the proper care of the wounded, we find Germany, fully prepared for England's embargo, making a soft, absorbent surgical cotton from wood cellulose. Two factories in Sweden also are making this substitute. Slings are made from tough crêpe paper, and splints from fiber boards.

"To Be Without Wood Is Almost as Bad as Being Without Bread"

Wood is also contributing to the personal comfort of the men at the front. Russian soldiers are wearing paper skirts made in Japan, where such clothing has been in use for many years. The chief raw material for the manufacture of paper is, of course, wood pulp. Paper clothing is warm and cheap, and special waterproofing processes are overcoming its tendency to tear when wet. It may be discarded when soiled—an advantage to the soldier from the standpoint of hygiene. The Germans and Austrians, mainly the poorer classes of the civilian population, use paper vests, socks, and handkerchiefs. Blankets and coats are padded with cellulose wadding. So many paper articles, in fact, are produced for the comfort of the people of Germany and Austria as to lead the socialist organ "Vorwaerts" to declare, "To be without wood is almost as bad as being without bread."

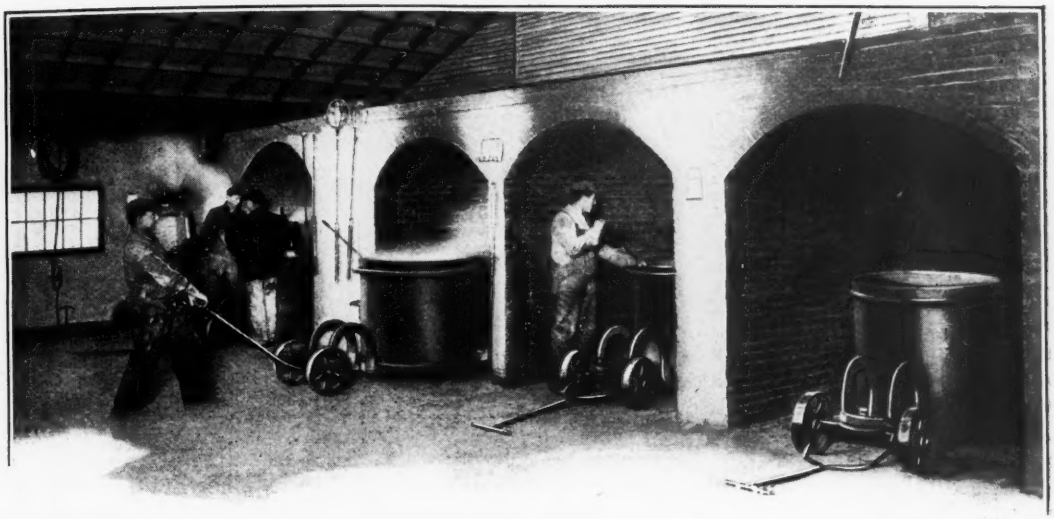
The demand for newspapers and periodicals of all kinds increases enormously in a time of national crisis. The bulk of print papers is made from spruce and balsam fir. Experiments have shown, however, that satisfactory newsprint paper can be made from some seven or eight other American woods, which places the United States in a position of preparedness as far as paper is concerned.

How Paints Are Made

The chemist has changed the paint industry. You don't mix your paints nowadays. You buy them ready mixed

By Henry A. Gardner,

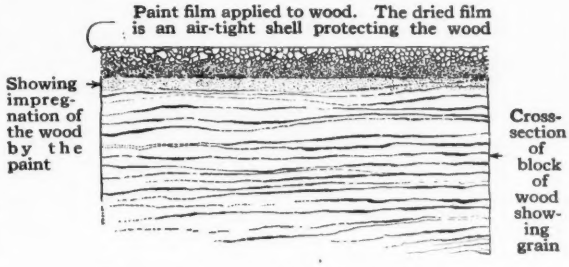
Assistant Director, The Institute of Industrial Research, Washington, D. C.



No, this is not a soup kitchen. It is a room in a varnish factory where the expensive fossil resins are melted in copper kettles of one hundred-gallons capacity preparatory to mixing and canning

THE owner of an average house will probably be surprised to learn that every time he paints it about one hundred and fifty pounds of metallic lead and zinc are used. For that reason, the film of paint that serves to protect the wood may be thought of as a metal shell.

The average mixed paint contains in every gallon about ten pounds of lead and zinc that has been transformed into white powders by chemical processes. These white powders, which are called pigments (white lead and white zinc), are ground in linseed oil to produce paints. White lead is produced by corroding metallic lead with vinegar and gases or by subliming lead ores in special furnaces. White zinc is produced by heating zinc ores with coal. At a high temperature the zinc forms a white smoky fume which is cooled in long flue pipes. Other forms of white pigments, such as finely ground china clay and talc rock, are used in the paint industry. An almost endless variety of chemical colors are manufactured for paint. These colors are made from metals such as lead, zinc, chromium, iron, antimony, copper, cobalt and cadmium, as well as from certain coal tar dyes. Nearly five hundred different base colors are used by the large paint makers.


Paint film applied to wood. The dried film is an air-tight shell protecting the wood
Showing impregnation of the wood by the paint
Cross-section of block of wood showing grain

Cross-section of a block of wood showing impregnation of the wood by the paint

Paints are Mixed Like Dough

In making paints, the white pigments are mixed in proper quantities with linseed oil in large mixers containing revolving knife blades and stirrers, such as are used in a bakery for mixing bread dough. The paste formed is then run through mills containing closely set revolving plates of

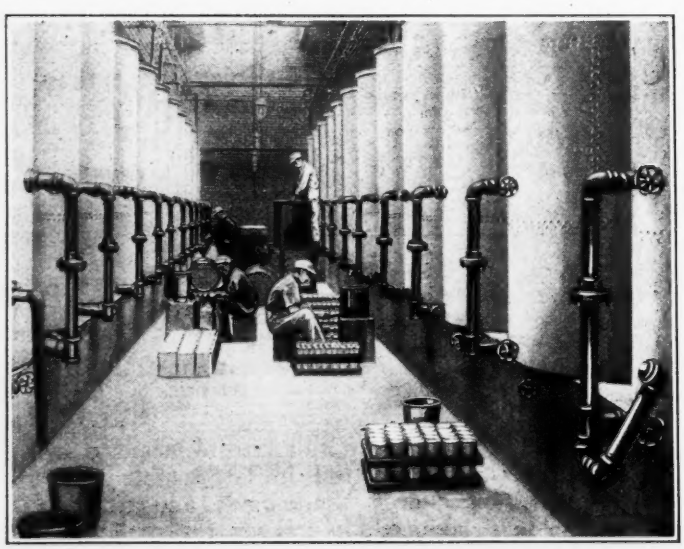
Menhaden fish are not used for food. They are steamed and pressed to extract their oil, which is used in making paint

Below: On the right is a barrel filled with dry pigment. The barrel on the left contains the same pigment after it has been milled with the requisite amount of linseed oil. Condensation reduces the volume

dressed stone. The paint comes from the mill very smooth, and finely ground. It is allowed to flow into large tanks holding sometimes a thousand gallons or more, where it is thinned with oil, turpentine and drier. Tinting colors are added if a colored paint is desired.

Linseed oil forms the liquid part of most paints. When brushed out, it takes up oxygen from the air and becomes solid, forming a rubber-like substance which is very waterproof. When pigments are added to the oil, the same thing happens, but the dried oil is made stronger and the surface to which it is applied is colored, according to the colors of the pigments used. Oil squeezed from menhaden fish is used in some special kinds of paint. Oil from the nuts of the Chinese wood-oil tree is very useful for making highly waterproof paints. It has been used by the Chinese for many centuries to smear their junks and river boats. Oils expressed from the soya bean, cottonseed and corn germs are used to some minor extent in the paint industry.

Turpentine is produced by distilling the resin that comes from pine trees and is used in paint to make it spread easily, to aid it in drying and to help it penetrate deeply into the grain of wood, thus securing a good bond. Mineral spirits obtained by distilling petroleum is used for the same purpose.



Filling cans with the prepared varnish and paints from a battery of storage vats in one of the great paint factories

Varnish Is Made from Prehistoric Tree-Oozings

Paints which dry with a high luster or gloss are called enamels. These are made from zinc oxide ground in varnish. Varnish is produced from fossil resins such as copal, kauri, etc. These resins, which originally flowed from trees, have been deposited for centuries in the earth. They are mined in Africa and New Zealand, and are found in big lumps.

Telling the Age of Water-Marks On a Lake Shore

A RECENT investigation of the water level of lakes by two consulting engineers, one an American and the other a Canadian, resulted in the collection of interesting data on the age of water-marks and stains on the rocks along a lake shore. Moss and lichens, common vegetation in northern latitudes, play an important part in this study, the water stains on the rock being due to the absence or partial absence of one or more forms of these lichens. The removal of these lichens and the formation of a mark by standing water may occur in a comparatively short time, possibly in a season, but a number of years are required to change substantially the sharpness of a water line once formed.

One of the accompanying illustrations shows clearly the appearance of these stains or water-marks. It may be noticed that the marks are higher on the exposed face of the rock than around the corner where the rock is protected to some extent from wave action. The other illustration suggests the length of time required to alter a mark. On this rock a high-water mark was cut in 1895 at the point indicated by the pencil. It is still plainly visible and practically unaltered, although it is no longer the high-water mark for that particular locality.

One of the most interesting series of water-marks left by large inland bodies of water may be seen on rocks which now lie far above the level of Great Salt Lake. These rocks tell the story of the lake's gradual evaporation.

On the rock shown in the illustration at the top a high-water mark was cut in 1895. In the oval appear water-marks and stains

Replacing Rags with Waste Tanbark in Making Coarse Paper

TO-DAY the price of plain everyday rags is soaring high above the clouds in company with that of most commodities. Its use in the manufacture of paper has therefore greatly diminished. Not that we are making less paper than before, but because a cheaper substitute has been found for the rags. This substitute is waste tanbark. In the manufacture of wall-paper alone fully eighty per cent of the rags previously used are being successfully replaced by it.

The greatest total saving that tanbark is effecting, however, is in the production of felt shingles for roofing. The United States has been manufacturing nearly nine million square feet of these shingles each year. The material entering into them weighs about two hundred and forty thousand tons. Of this, by far the greatest part has been made of rags. But now over thirty per cent of this is being replaced by the tanbark, and the finished product is as satisfactory as it ever was.

The tanbark is made up of the bark of oak and hemlock trees. Some seven hundred thousand tons of it had been going to waste each year. But now, after the valuable tannin has been extracted from the waste, every scrap of it is being put to this new usage. Even the worn-out tanbark flooring used in riding academies and for exhibition purposes may be used again in this way.

It would seem then that felt shingles for roofing would be one of the few manufactured articles the price of which has not been augmented by the war.

This warning is placed on all streets to be paved, as far in advance of the work as possible

How Baltimore Protects Newly Paved Streets and Saves Time and Trouble

BALTIMORE, Maryland, has adopted and proven entirely practical a system which reduces the number of "cuts" in streets and which has eliminated the tearing up of new pavements for the laying of gas and water mains or services, sewer pipes, conduits and the like at different times.

1st. A list of streets to be improved is advertised in the daily papers four times within a period of six weeks.

2nd. This list is sent to all city departments and to all public service corporations operating within the city limits.

3rd. A printed form notice is served on each owner or leaseholder of property abutting on streets to be paved. This form contains some good advice on "Before," "During" and "After" paving operations.

4th. A conspicuous "WARNING" sign about three by four feet is erected on temporary standards about a street block apart along the thoroughfares which are to be improved, and as far in advance of actual paving work as is possible. These signs are painted in large white letters on a bright red background as follows:

WARNING!

THIS STREET WILL BE PAVED!
All underground structures, gas and water pipes, etc., must be put in at once

After completion, no permits to cut will be granted for five years.

***James H. Preston,* Mayor.**

By the strict enforcement of this regulation, city officials have convinced contractors that they are in earnest in their determination to make one cutting up of a street the limit for necessary installations.

Quartering Potatoes for Seed with a New Double-Blade Cutter

EVERYBODY knows that potatoes grow from the "eyes" cut from other potatoes. But only a farmer knows how to cut the eyes so that the largest and healthiest potatoes are obtained. Even he can stand improvement in his methods of cutting. Nine farmers out of ten use an ordinary single-blade "potato" knife. But the cutter shown in the photograph will double, and even treble, the speed of cutting.

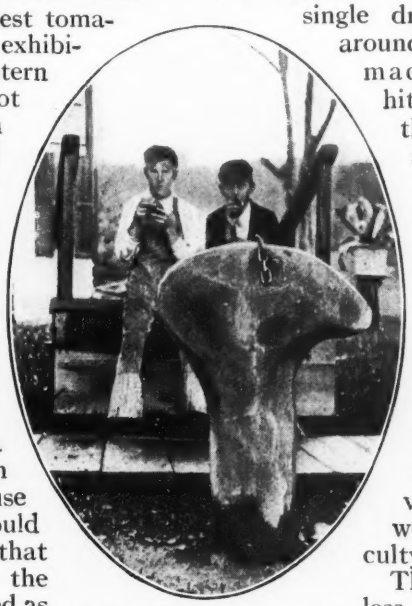
The forward stroke against the double blade of the knife halves the potato, and the backward stroke quarters it

This cutter has a double-edged blade held vertically in front of the operator. With the horizontal guide below it, the blade is securely held in position by steel bracing which is attached to the iron board upon which the operator sits. A potato is taken in both hands and pushed sharply against one of the edges of the knife. The smaller of the severed pieces is dropped into the basket, while the rest is pulled back against the other blade, to be cut again.

Nature Hides a One Thousand-Pound Stone Tomahawk in a Coal Mine

THE biggest and sturdiest tomahawk ever seen is on exhibition in a little town in Western Pennsylvania. It was not fashioned by an Indian "brave" nor by the hand of any man, but was made by Nature herself of solid rock. A coal miner, digging away in the bowels of the earth, came across the natural curiosity and with the help of his fellow workers brought it to the surface.

It is composed of one rock and weighs about a thousand pounds. When the question arose as to the use to which the tomahawk could be put, it was suggested that the handle be sunk in the ground and the head be used as a hitching post. This was done. The handle was set three feet in the ground and a steel stake and chain fastened to the top. There is no horse in Pennsylvania fractious enough to pull it up.



A hitching post of stone which resembles an Indian's tomahawk. It was found in a coal mine

Hitching a Modern Motorcycle to an Old-Fashioned Buggy

HE needed a horse to haul a buggy, and so V. L. Snyder of Douglas, Oklahoma, used his high-powered motorcycle as a substitute. Only a few minutes were required to harness the machine between the shafts. The breast band of the single driving harness was put around the forepart of the machine and the traces hitched to the singletree in the usual manner. A short rope was provided to support the shafts and hold-back straps to keep the buggy from running over the machine when making quick stops. Two passengers rode in the buggy and two on the motorcycle.

The combination proved to be a decided success. Several miles of country roads were traversed and numerous hills were climbed without difficulty.

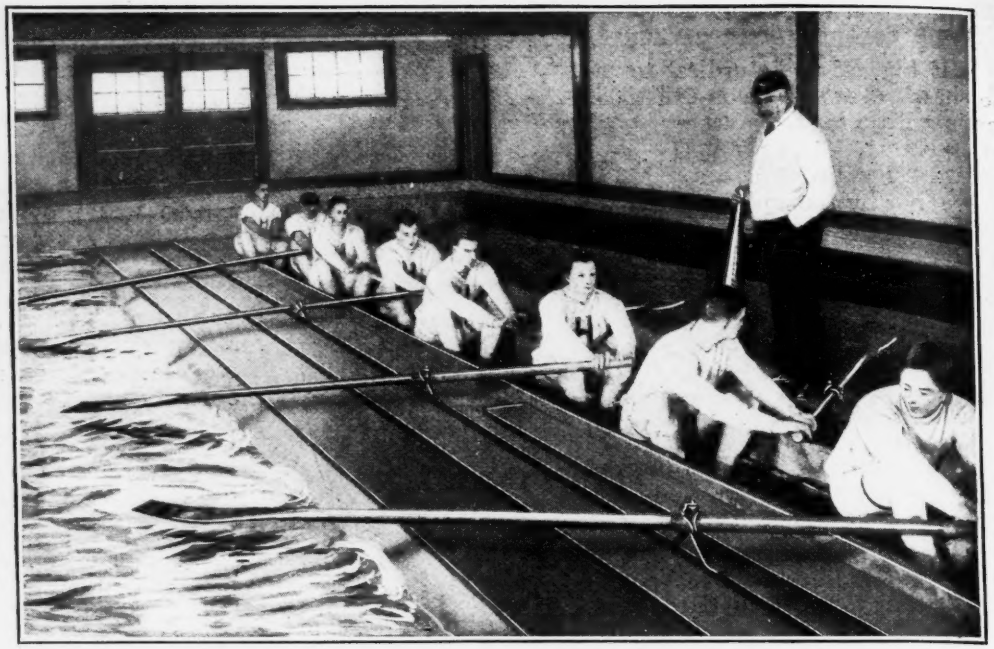
The four passengers doubtless made better time and were more comfortable during the trip than if they had all been crowded into the buggy with Old Dobbin in the traces. The motorcycle proved fully equal to the horse's job.

The motorcycle not only drew the buggy over hill and dale but carried two extra passengers with ease

Some Curious Fires Which Extinguished Themselves

A FIRE in a church in Boston, Mass. melted the lead water pipes in the storeroom where it started, and the water gushed forth as from the firemen's hose.

A manufacturer of metal pails, with an establishment in Philadelphia, has his conscientiousness to thank for saving his plant from a fire recently. His orders were that all finished pails be filled with water and left suspended from the ceiling for a time in order to test them. During the noon hour one day, while the men were at dinner, fire broke out in the testing room, heating the upper portion of the room to such a degree that the solder of the bails connecting the pails melted and the pails dropped, splashing water all over the place and putting out the fire.



Harvard's varsity crew practicing on their indoor river course in the rowing tank at the Newell Boat House, rowing hard against a current produced by a gasoline motor

Training Harvard's Crew on an Artificial River with a Real Current

WHEN it is impossible for the members of Harvard's crew to practice on the river, the men are taught the art of rowing in the tank at the Newell Boat House.

To make the indoor practice as similar as possible to actual rowing conditions on a river, a stiff current is set up in the tank by propellers operated by a gasoline motor. Indeed, rowing in the tank of moving water is harder than it is on a river with a strong running tide, because the boat is stationary and the water moves in the same direction as the stroke is taken. The boat is thirty-eight feet long and has sliding seats.

Converting an Automobile Into a Farm Workhorse

AN attachment recently placed upon the market by a manufacturer in Tacoma, Washington, enables the farmer who owns a small automobile to convert it into a tractor and back again into a pleasure car. To convert the automobile into a tractor the body and mudguards of the machine are removed, a small pinion gear is applied to the axles in place of the rear wheels, heavy steel tractor wheels are substituted for the automobile wheels, and by means of clamps a steel rim six inches wide is placed on the front wheels after the tires have been removed, as illustrated below.

By removing the body, mud guards, rear wheels and front tires of the pleasure car and substituting tractor wheels and a small pinion gear in their place a farm tractor is created

Safeguarding Open Drawbridges by an Automatic Car-Stop

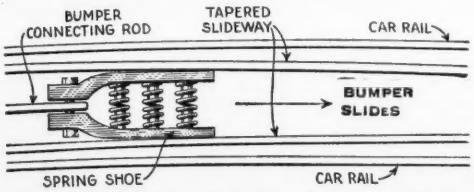
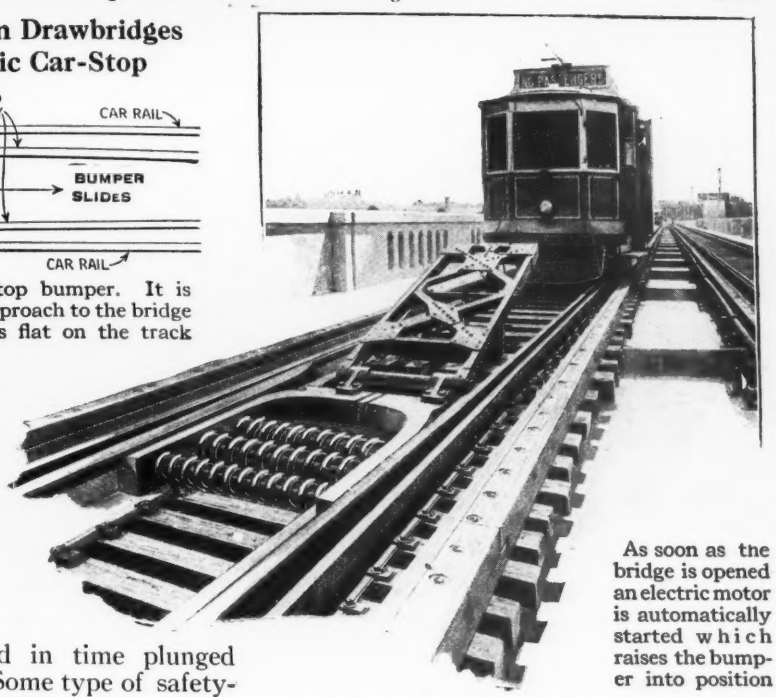


Diagram of the safety-stop bumper. It is placed at the end of the approach to the bridge and when not in use lies flat on the track



As soon as the bridge is opened an electric motor is automatically started which raises the bumper into position

DRAWBRIDGES which have been opened too quickly have caused many fatal accidents. Only recently accidents were caused in this manner in Boston and Chicago, where in each case trolley cars that could not be stopped in time plunged down into the water. Some type of safety-stop should be provided on every drawbridge. That it is perfectly feasible to provide such stops is proved by the accompanying photograph which shows the type of stop now being used on a bridge having an upgrade approach. It is the design of a Chicago engineer, J. B. Strauss.

The Strauss safety-stop is placed at the end of the approach to the bridge. When not in use, it lies flat on the bed of the track. But just as soon as the bridge is opened, an electric motor is automatically started which swings the front end of the striking-frame around on its pivot, until it is raised about two feet above the track. The heavy pivoted end of the heavy steel structure of this frame is held securely down. A car which strikes the frame can get very little nearer the edge of the approach than the front of it. In all ordinary cases, the collision will not be severe and the bump will certainly be preferable to a plunge into the river.

It Takes Four Thousand Characters to Typewrite in Chinese

A MECHANICAL engineer of Shanghai, China, has invented a Chinese typewriter with a revolving cylinder about six inches in diameter and sixteen inches in length, on which four thousand of the multitudinous Chinese characters are distributed over an ordinary matrix.

The "keyboard" consists of a flat table surface upon which are duplicated the type characters. To write the letter "A," for instance, the pointer at the end of a rod attachment is placed directly above the character as it appears on the flat table keyboard. Then a hammer is dropped on a plunger and the impression is made. Several carbon copies may be secured.

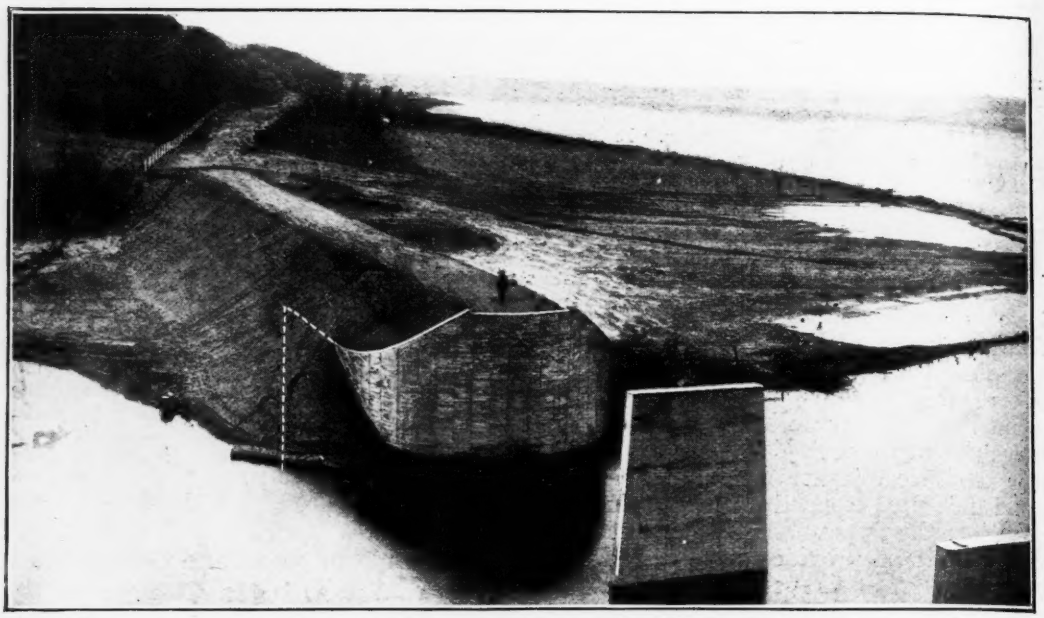
The rod attachment which locates the characters on the keyboard also turns the type cylinder and moves the carriage.

The machine weighs about forty pounds.

A push of the thumb operates the hammer on this Chinese typewriter and moves the spacer

It's Sheer Weight That Keeps a Pier in Place

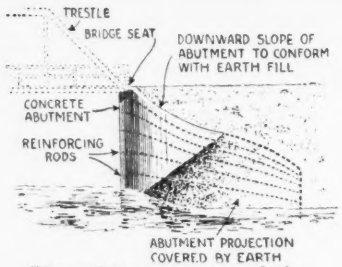
Here is an inexpensive way to get the necessary amount



The new type of pier instead of being cast into a solid block is made in the form of a hollow semi-circle the ends of which are extended backward in the form of two parallel walls

ONLY a few years ago, the piers which supported the shore ends of a highway bridge were made of huge, massive blocks of concrete. The sheer weight of the concrete steadied them and prevented their slipping away or overturning with the bridge into the river. Upon this principle of operation, however, these piers could never be made too large. Indeed, the danger lay in possibly making them too small. Evidently, they were very expensive.

No wonder then that engineers have been giving the problem of the highway bridge much attention. The result has been most satisfactory. An American engineer has lately brought out a highway pier which works on a more scientific principle. His pier, illustrated in the accompanying photograph, is just one half as expensive as the older types, while in some cases, it has even proved better and stronger than they could have been.



Plan of the new type of pier. The convex face of the semi-circular wall faces the river

Instead of casting the piers into a solid block, those of the new type are being made more in the form of a hollow semi-circle. The ends of this semi-circle are prolonged backwards in the form of two parallel walls. The convex face of the semi-circular wall faces the river. A wide rectangular-shaped notch is left at the top of this part, directly in front. The land-end of the bridge fits into the bridge-seat thus formed. The prolonged ends of the pier slope downwards away from the river.

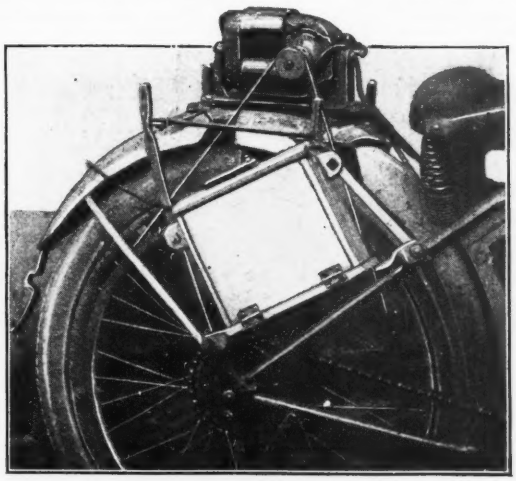
The piers are made a foot thick all around. A number of heavy steel rods are cast in the concrete of each pier. These rods run nearly parallel with each other around the piers as shown in the diagram and they greatly reinforce the entire structure. Earth is dumped into the pier to fill up the hollow inside. The two extending walls are then deeply buried in earth also. It is the weight of this earth which prevents the pier from slipping.

FOR PRACTICAL WORKERS

Dynamo Lighting System for a Motorcycle

Winner of Third Prize in Contest

THE modern automobile with its self-contained electric plant is much envied by the motorcyclist, but electric lights are equally possible for the motorcycle, with the dynamo in the illustration. Take a rim of an old bicycle wheel and bolt it on the rim of the motorcycle to make a belt drive for the dynamo, which is fastened on the luggage-carrier supports. The dynamo used on the motorcycle illustrated was a discarded one taken from the ignition system of an automobile. The headlight used carried an 8-volt, 12 candlepower bulb. In running from 4 to 40 miles per hour a good light is produced. When not running, a switch is used to turn the current on from the battery. The battery consists of 4 cells of dry battery placed in a box that is bolted on the braces of the luggage carrier.—DAVID W. FREYE.



The dynamo mounted on the luggage-carrier supports is driven by a belt from the rear wheel

Things to Know About Your Motorcycle Clutches

THE clutch, the intermediary between engine and rear wheel, has been to many motorcyclists more or less of a mystery. Indeed, some of the early clutches were weird and wonderful. However, modern motorcycles are equipped with clutches which if properly used and cared for will give excellent service. In principle, a clutch consists of a number of disks contained in a circular casing. Every alternate disk is secured by projections around the periphery which fits in grooves in the casing. On the outside of this casing is mounted a sprocket connected with the motor sprocket by means of the short drive chain. The countershaft, by means of which power is transmitted to the rear wheel, extends within the clutch casing and carries the other alternate disks by means of projections on the central hole of these disks. Strong springs are used to clamp the disks integrally together when driving, and a screw-operated thrust bearing is used to compress the springs and free the disks when the clutch is thrown out. Two general types of clutches are in use—the dry plate employing steel surfaces in contact with raybestos linings, and the grease or oil lubricated steel on steel clutch.

With proper usage, the dry clutch should not require new raybestos linings oftener than once a season. When polished and dry, the linings may be improved by the application of glycerine. As the linings wear down, the copper rivets should be inspected carefully to see that they do not project above the surface of the linings. If the rivets do project too far, they will come in contact with the steel plates and cause the clutch to become harsh and jerky. The

rivets should be hammered with a punch below the surface of the raybestos. The only additional attention required is occasional lubrication of the bearings, and tightening of the screws which regulate the spring tension, to compensate for the gradual wear in the raybestos linings.

The all-steel plate clutch requires packing with some lubricant at intervals. For this, the plates should all be removed, wiped off and greased with a thin coating of heavy grease into which a generous quantity of flake graphite has been worked. Flake graphite will be found to adhere longer to the disks than the granulated form.

The all-steel clutches may be made much more flexible and smooth by substituting molded raybestos disks (obtainable from almost any motorcycle dealer) for some of the steel disks. These raybestos disks are not secured in any way and merely serve as floaters or separators to keep the steel plates from sticking together. The usual steel disk clutch contains from eight to eleven steel disks. If four steel disks are eliminated and two raybestos disks added, the clutch will be made very smooth, jerking will be eliminated and the clutch will seldom require lubrication.

A tight short drive chain is a frequent cause of clutch trouble, throwing an undue strain on the bearings. Unnecessary tightness of the chains also breaks the rollers, stretches the chain and wastes power.

Several troubles are encountered with steel disk clutches used on some of the 1913-1914 motorcycles. In these clutches, the spring tension is regulated by screwing in a plate which forces the springs against the clutch disks. The central threaded hole in this plate is about 3 in. in diameter and the thread is the fine motorcycle 24 standard, and screws on a shaft extension or hub. After the clutch has been taken apart a few times, the thread becomes worn and it is impossible to screw on the plate against the spring tension. The usual method of screwing this plate on by means of a hammer and punch or blunt chisel is not conducive to thread conservation. With the usual number of disks (8) this clutch has an excessive amount of surface. If a couple of disks are left out, the clutch will work as well, and it will enable the plate to be screwed in on good threads which will hold against the spring tension.

Another trouble is in securing the control clamp to the thrust-bearing collar. Roughing the thrust-bearing collar on an emery wheel or inserting a piece of emery cloth underneath the clamp will be found to prevent this from slipping.

Continual slipping of the clutch which does not respond to tightening of the springs is generally due to the springs being weak. The remedy is new springs.

In adjusting the clutch controls, be careful not to have the thrust-bearing so tight as to prevent the clutch from going all the way in. When the clutch is in tight, there should be some play in the bearing.

Always leave the clutch in when the machine is not being used. If the clutch is left out, the springs will soon lose their tension.—WESLEY G. PAULSON.

New Clay Pigeons That Break with a Single Shot

THERE is probably nothing more exasperating to the expert trap shooter than to know that he has struck a flying target and yet to see it soar gracefully away as if no shot had touched it. A clay pigeon has been brought out that will do away with such an annoyance, for it will break if hit by but a single shot.

The strain causes the clay to break easily

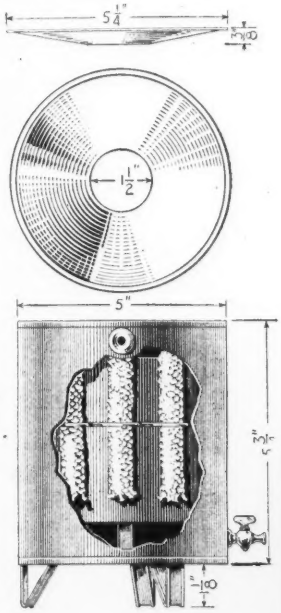
In making these pigeons the inner part is chilled suddenly from a heated condition. This tends to make them very brittle. The material used is a species of glass, although the finished product is still known as a clay pigeon.—H. C. RIDGELY.

An Alarm Clock for Awakening the Deaf

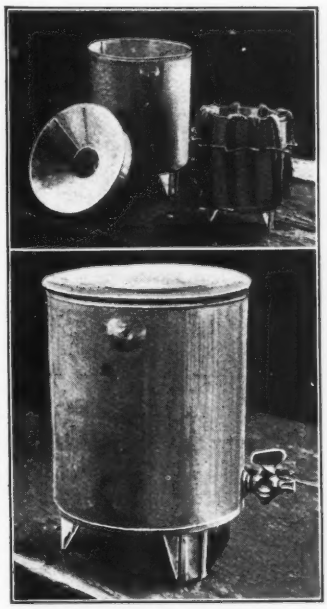
HAVING been awakened by a light suddenly turned on in his room, a deaf man devised an alarm clock to arouse him each morning by this method. An ordinary alarm clock was purchased at a department store and electrical attachments were made to turn on the current for the light. A high candlepower light was hung from a pull-switch socket placed near the sleeper. The clock is wound and set in the same manner as any alarm clock. Attached to the winding key is a spool on which is placed a cord. The loose end of the cord is tied to the pull-chain of the electric socket. When the time arrives for sounding the alarm the revolving key and spool take up the cord and thus turn on the light.—FREDERICK J. KNOB.

A Small Filter for Light Machine Oils

A GREAT many differently constructed practical filters can be made for light machine oils, where they are not circulated too rapidly or in a great quantity. The results sought in such a locally constructed device are simplicity of parts, operation and oil delivery.



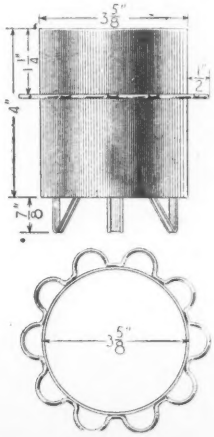
The illustration shows a filter which is very serviceable where the oil is required to be thoroughly cleaned but is not needed in a very great quantity. The outer shell may be built from any tin can or receptacle of a suitable size. Another receiver of the same nature, but a trifle smaller is used for holding the dirty or filtering oil. A number of strips of candle wicking or light cotton rope are thrown over the sides of the inner can and held to the outside by means of the looped wire strip. Through the strong capillary action of the oil and rope or wicking the best of the oil is raised, and drips down into the outer shell where it is drained off as it is wanted. The inner receptacle should be cleaned as often as necessary. The dimensions given are for a filter that was made and used with excellent results.—F. W. BENTLEY.



The filter for separating the oil from the sediment

Getting Rid of the Destructive Attacks of White Ants

WHITE ants are pests the attacks of which must be guarded against, since they may seriously damage wooden structures, stores of food and clothing, field crops and plants. They have been known to eat out the core of a wooden beam for several feet before being discovered. Woodwork which is in contact with damp soil is especially likely to be infested. The ants colonize in large numbers and attention is generally attracted to them by the passing in and out of the flying members of the colony during the swarming time in the spring. Long tracks of earth leading to a section of a structure is also an indication of their presence. If infested timber has not been weakened too much, it need only be frequently drenched with kerosene; but if it has been too much eaten away, it will be necessary to replace it with new timber. Treating the new timber with coal-tar creosote will keep the ants away. If the colonies nest in the ground near the wood, applications of carbon bisulphide may be used.



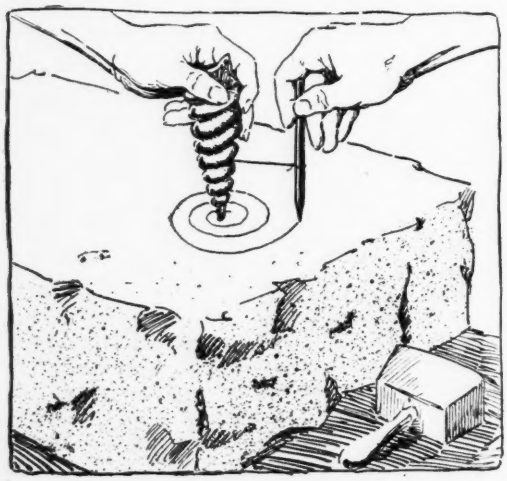
Should stores of food and clothing be attacked, the rooms in which they are stored should be thoroughly sprayed with a 5 per cent solution of kerosene emulsion. The clothing and similar goods should be aired in the sun.

Field crops and plants are liable to be attacked when near ground which has been recently cleared and which contains decaying logs and stumps. Such attacks can generally be prevented by plowing late in the fall the ground in which the crops are to be planted. Should the pests appear in spite of this, the young sprouts should be sprinkled with the 5 per cent kerosene emulsion. Infested trees and flowers should be treated with the solution in the same manner.

Drawing Outlines for Forming Scrolls on Ionic Capitals

THE secret of the beautiful curves of Ionic architecture is said to be traceable to a seashell.

The skillful artist fastened a string to the stylus and then wound it about the shell from the top to the bottom. The shell used was in the form of a top with a spiral groove running down its side. The point was placed in the center of the proposed scroll and the mark was made with the stylus, pulling at the same time on the string, which gradually unwound from the shell and released an ever lengthening radius for the stylus to work in. This produced a scroll with an accurate and beautiful curve. Various types of scrolls were produced, according to the size and shape of the shell.—HAROLD V. WALSH.



The method employed in forming Ionic scroll-curves with the aid of a periwinkle seashell

Marking Date of Repairs on Automobile Tires

HOW can I mark my repair work for future identification? This is an oft-repeated question that comes from repairmen who have tried many systems. Here is a scheme that has been found very efficient: A tin strip, ½ in. wide and just long enough to make the necessary figures, is stamped by a machine that punches the letters in backwards. This strip is placed against the uncured rubber, with the embossed side of the tin turned out. When the job is cured the tin strip is peeled off and the rubber is found to have been forced into the little grooves of the letters, forming a perfect mark. The average repairman might find such a punching machine a little too expensive for his requirements, but by providing himself with a set of letter punches, which as a general rule are inexpensive, with a hammer he could make a few of his own strips.

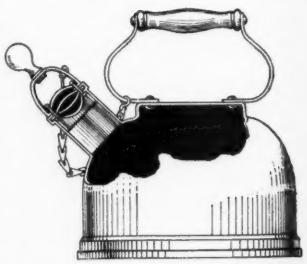
Probably the best place to mark a tire repair job is close to the bead. The repairman might save labor if he punched his initials on a separate strip, for then strips with just the dates could be made up each morning as needed.

Re-Shellacking a Cork-Float on an Automobile Engine

WHEN re-shellacking the cork-float of a carbureter it should be first carefully sandpapered to remove all particles of the old shellac. If this caution is not observed, additional weight will be added to the float which will necessitate a readjustment of the carbureter. This may seem unimportant, but it will result in trouble when starting the engine. A very slight change in the weight will cause considerable difference in the amount of gasoline admitted and unless the reason is known it is hard to locate the trouble.

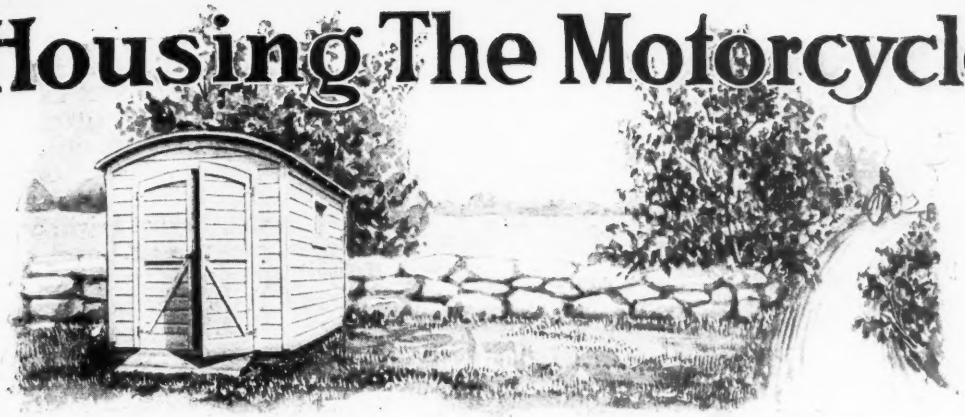
Tea Kettle with Whistle in Spout for a Signal

THIS kettle has no detachable top but it is provided with a generous spout through which it is filled and emptied. Attached to the handle by a chain is a small signal whistle which is slipped into the spout to announce the boiling point. There is possibility of a small fuel economy due to the scarcity of vents and the undoubted advantage of having no cover to slip off during the pouring operation.



Tea kettle which is filled and emptied through spout

Housing The Motorcycle

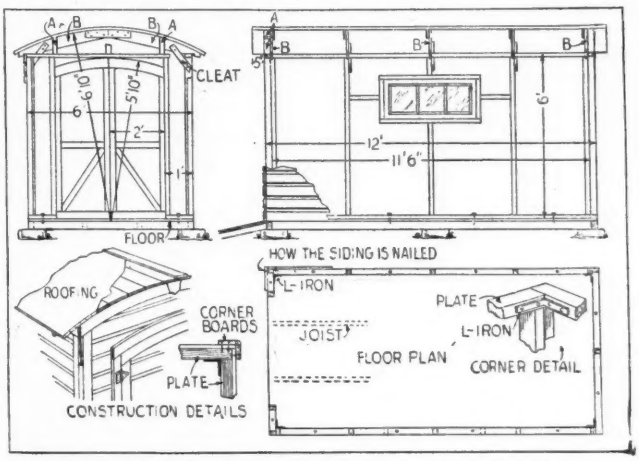


By B.M. Ikert

This article won the first prize of $25 in the Motorcycle Contest which closed December 30, 1916. Hundreds of ideas were sent in on the repair, upkeep and field of usefulness of the motorcycle. The Popular Science Monthly bought the best ideas and will publish them during the course of the year.—EDITOR.

ALTHOUGH any kind of a shed will do to house a motorcycle, the portable garage here described possesses many advantages over the simpler type of structure. The initial cost is small, and as the building need not be much larger than 6 by 12 ft., it can be put on a small back lot or at the rear of an apartment-house grounds.

The cost of the material will, of course, vary in different parts of the country, and the owner will save considerably if he does the work himself. The garage shown cost, together with paint and hardware, about $30; but the owner did the work. From all outside appearances, it resembles a permanent structure, but it can be taken down in about an hour's time. It is made in seven very easily adjusted sections, comprising the floor, two sides, two ends and the roof, which is made in halves. The sides and ends are covered with drop-siding, while ordinary boards are used for the roof which is then covered with roofing paper. One window is provided, and this is hinged at the top so it can be swung up and hooked on the rafter, while the doors, each one of which is 2 ft. wide, swing outward.

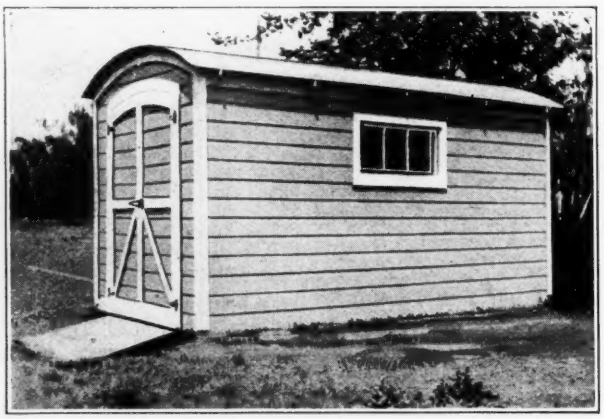


End and side elevations with floor plan and detail of corner and roof for making a motorcycle garage

About the first thing to do, after having selected the building site, is to procure six large flat stones and place these as shown, one at each corner and one in the center on the sides. A rectangular frame should now be made measuring 6 by 12 ft., outside dimensions. This frame is made of 2 by 4-in. scantlings and should have two joists running parallel with the side members and about 24 in. apart. See that the frame is level and resting on all the stones, which should, of course, be level. Next cover it with the floor boards, which can be plain or matched, the latter making the better job. Trim the flooring flush with the outside of foundation frame, and this

will finish the first unit of the structure.

The framework for the sides and ends is made of 2 by 3-in. stuff, which is ample for so small a building. The ends are made up first, and these should measure 6 by 6 ft. As will be noted, the front end frame consists of four uprights nailed to two 12-in. lengths at the bottom, and crossed at the top by the plate. The 4-ft. space between the inside studs forms the door space. For the rear end all that is required is a framework 6 by 6 ft. built as shown, with a single stud placed in the center. When both ends have been finished they can be set up on the floor and secured to the latter by lag screws. It will be seen that these screws extend down through the floor and into the 2 by 4 pieces below, insuring rigidity to the structure all through.



The side in which the window is placed. Two windows may be used but one is sufficient for a small building

To get out the framework for the sides, practically the same procedure is followed as was used for the ends. The top and bottom members are cut to 11½ ft., and five studs are placed as shown. The two sides are identical except for the window, which is placed on one side only. However, if desired, a window can also be placed on the other side. The size of the window is determined by the builder, but it will be found that one measuring about 16 by 40 in. is large enough. Set the two side frames between the ends and fasten with lag screws, as was done with the ends. At the top, the ends and sides are fastened together by means of angle irons, as illustrated in the detail drawing.

For the siding, ordinary boards could, of course, be used, but if a particularly neat looking job is desired, drop-siding makes an excellent material. This can be placed before the roof is put on. First, see that your framework is square and plumb, then beginning with the bottom board, nail the siding to the studs. Let the boards on the ends extend over those on the sides, but be careful not to nail any of the side boards to the ends. The proper method is shown in the upper left-hand corner of the floor plan. The siding is carried to the top of the plate on the sides, but at the ends it must be built up about 1 ft. higher. In doing this, nail on short pieces, marked *A*, of the 2 by 3-in. stuff, to the end plate. It is not necessary to cut these to the exact height as yet, but make them about 1 ft. long. Now carry the siding up to cover these pieces and proceed to trim it to the rounded shape shown. Procure a stick about 7 ft. long and drive a nail about 1 in. from one end and another 6 ft. 10 in. from this. Drive the first nail into the floor exactly in the center of the doorway and let the other nail protrude slightly. Using the stick as a sort of beam compass, let the nail describe part of a circle on the top. Drive another nail 5 ft. 10 in. from the center of the circle or first nail, and this will give the shape of the top of the door opening. If the siding at the top has been nailed only temporarily, it can be taken down and the curved line cut more easily.

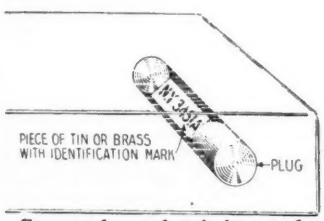
To get out the rafters *B*, tack a board at the top of one of the ends and draw a line using the same radius as was used at the top of the ends. Cut ten pieces for the rafters, which are notched to fit over the sides and fastened in the center with cleats, as shown. In fastening the cleats, use screws, so that when the building is taken down, the screws on only one side of the cleat need be removed. Set the five rafters as shown and fasten them by cleats to the studs, using screws as before. Nail the roof boards on, letting them extend over about 5 or 6 in. These should be so placed that two of them form a joint at the center, running the entire length. Cover the roof with one of the many roofing materials on the market and run a knife along the top central line, thus dividing the roof into two parts. Next cover the joint with a thin batten, held down by screws.

The door is made in two parts, of the dimensions shown, using the same kind of material as was used for the siding of the building. By nailing on the curved facial boards to the ends and those on the sides, together with the corner boards, a neat looking building results. The boards fitted at the top of the sides must be matched to fit the projecting rafters. Care must be taken to nail the corner boards as shown, and in fitting the quarter-round molding, nail it to only one of the boards. Then when the ends and sides are taken down, the molding will come with whichever board it was nailed to.

From the foregoing description, it will be noted that the building can be taken down very easily and in a comparatively short time. If it is desired to do this, the thin batten on the roof is first taken off and the screws on one side of the cleats, joining the rafters, taken out, the cleats remaining fixed to the other rafter piece. Then remove the cleats holding down the rafters to the studs. The roof can now be lifted off in two sections. Next remove two of the screws in the angle-irons which hold the ends and sides at the top. Only the lag screws at the bottom now remain to be taken out. A sloping runway is built at the front, resting on several large stones.

Marking an Automobile for Positive Identification

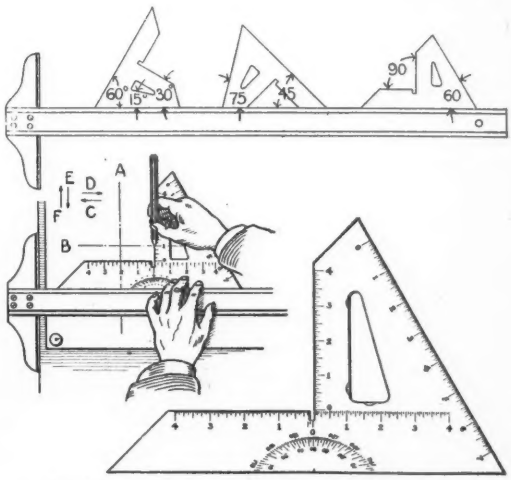
USUAL marks of identification on automobiles can be easily obliterated and a popular make will be difficult to claim. Here is a method I have used for marking tools, and it can be applied in the same way to an automobile so that the car may be identified beyond question. A small piece of sheet metal, preferably brass, is stamped with the owner's name, or other inscription, then rolled up closely and slipped into a hole drilled in the frame in some out-of-the-way place. The hole is then plugged and finished over so that it cannot be seen. The owner can easily locate the place and show conclusively that the car belongs to him.—C. A. JOHNSON.



Stamped metal strip inserted in hole drilled in the frame

A New Combination Triangle for Draftsmen's Use

THE illustration shows a triangle combining several unique features of value to the draftsman. In mechanical drawing two lines are generally laid out first; namely, the vertical center line and



A triangle with combinations that serve for various tools other than the ordinary one

the horizontal center line. If a line is wanted parallel to *A* and 2 in. to the right, the triangle is shifted along the T-square to the position as shown. By running the pencil along the vertical edge of the implement the desired result can be obtained. If the line is wanted 2 in. to the left, instead of to the right, it would simply mean shifting the triangle along the T-square in the direction of the arrow *C* until the 2-in. mark on the right horizontal scale is flush with *A*, then by running the pencil along the vertical edge of the implement the line wanted can be drawn. The same principle can be employed when measuring below the horizontal center line *B*, using, of course, the upper edge of the blade.

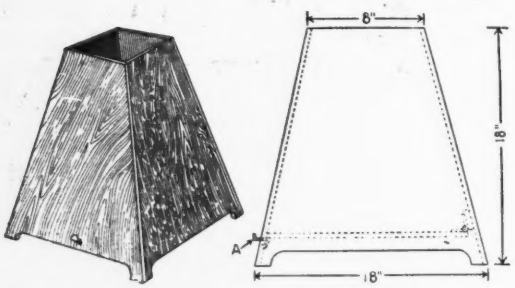
An Emergency Clothes Hanger Made from Roll of Paper

WHEN traveling or visiting, one frequently is so situated that a clothes hanger is not available. A good substitute may be made in a quick and simple way. Roll up a newspaper loosely and tie it in the middle with a piece of string, leaving a loop by which to hang it. This may be suspended from a gas bracket or from a handy hook.—JENNIE E. MCCOY.

A Novel Waste-Basket with a Drop Bottom

THE pyramidal shape of this waste-basket guarantees it against upsetting, even when bulky newspapers project from its top. The solid construction will hold the pipe-ashes and dust until it becomes necessary to dump them, and then the bottom may be unhinged and emptied completely by pulling the catch, so that it is not necessary to use the hands to take the papers out. If made of quartered oak, cypress or even of yellow pine, stained so as to bring out the grain, such a basket can be made an ornament to any room. It may be finished in any style.

The essential parts of the basket are the four sides and the bottom, the sides being of ½-in. material and the bottom, either of the same thickness or of 1-in. lumber.



Waste paper basket with drop bottom. Details and dimensions for its construction

Two of the sides are 18 in. wide at the bottom, tapering to 8 in. at the top; the other two are 1 in. narrower. These sides should be securely nailed together, as there are no inside supports. The construction is strong enough, however, for the purpose of such a basket. If the work is well done, with the nails countersunk and all holes and cracks puttied before staining, the joints will not be visible. The effect of the legs may be obtained, if desired, by cutting out the bottoms of the sides with a compass-saw.

After nailing together and sandpapering the whole, the stain may be applied. If it is desired to bring out the grain, apply the stain over only a small portion at a time. Allow it to set for a moment and then wipe off the surface with a dry cloth. The resulting tone depends on the time that the stain is allowed to stand and the amount of wiping done. When the stain has dried, the piece may be finished by rubbing with wax in the usual manner; or an almost equally good effect may be obtained by applying a coat of flat or mat varnish.

When the piece is thus prepared, the bottom may be fitted. It consists of a board a trifle less than 17 in. square, preferably with all four edges beveled to the same angle as the sides of the basket. Push this piece in from the bottom until it fits snugly, and mark the level on both sides of the basket. Remove it and attach hinges to one side; then replace it in the same position and fasten the hinges temporarily to the side of the basket. Placed in this way the bottom will not turn as desired until the inner edge has been shaved a trifle, and the amount of paring may be easily determined.

When the bottom is cut and fitted, bend a strip of spring-brass into the shape of the figure 7. Cut a narrow slot in the side of the basket opposite the hinges, just large enough to allow the end of the catch to pass. Slip the catch through and fasten the lower edge to the side of the basket. It should then be in the position shown at *A* in the detail drawing. It is evident that a pull on the catch will allow the bottom to drop. When the bottom is shoved back, the spring of the metal will again throw the catch into position.

While this completes the basket, it may be found that in beveling the bottom board to allow it to turn, there was too much cut away and that a crack large enough to permit some of the finer particles of dirt to escape is the result. If this is the case it may be remedied by gluing or tacking a strip of cloth over the opening, making sure to have sufficient play to allow the drop bottom to work.—A. E. SWOYER.

Cleaning the Crusted Carbide on Containers

THE sludge which forms in an acetylene generator has a very detrimental effect upon the apparatus when allowed to adhere to the surface of the metal, as it is very likely to do. A very simple remedy is to dissolve a little brown sugar in the water, which is allowed to act upon the carbide. Sugar, or saccharose, to give the substance its chemical name, has no ill effects upon the carbide, but forms a soluble compound with the lime in the sludge, known as saccharate of lime. This prevents the sludge from sticking to the metal.—H. J. GRAY.

An Accident Chart Showing Injuries to Miners

THE illustration is from a diagram prepared by the Bureau of Mines for the use of surgeons and hospitals in the mining districts in the selection of necessary sup-

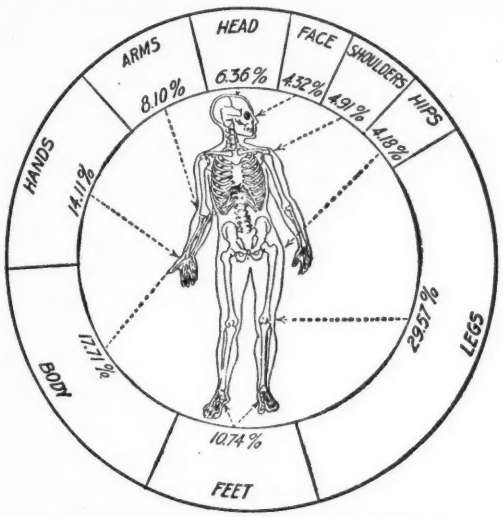


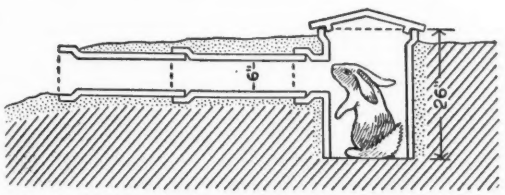
Diagram showing the percentage of injuries to the different parts of the body

plies. The diagram shows that practically 30 per cent. of accidents in coal mines result in injuries to the legs and about 14 per cent. to the hands, while accidents to other parts of the body are shown in relative percentages.

A Rabbit Trap Made of Ordinary Drain Tile

A CLEVER plan for catching rabbits is recommended by the Department of Agriculture. It is a trap which catches the rabbits alive, and almost any boy can construct one quickly.

The materials required consist of a 12-in.



The tiles are set in the earth so that a hiding-place is made for the rabbit

sewer-tile with a 6-in. side outlet and two lengths of 6-in. tiles. The long end of the larger tile is set downward in the ground so that the small side outlet is below the surface, as shown. The two small tiles are connected with the side outlet so that the opening will extend out to the surface.

The tiles are well covered with soil to exclude all light, and a close fitting cover is placed over the upper end of the large tile. The open end of the small tile may be surrounded with a few small stones and brush to make it inviting to the rabbits.

The rabbits are free to pass in and out of the dens thus made. When they are located in one of them it is an easy matter to close up the entrance and take them out of the large tile by raising the cover. Such traps are especially suited to open places or on prairie lands where rabbits cannot find natural hiding-places.

A Wall Book Shelf of "Built-in" Appearance

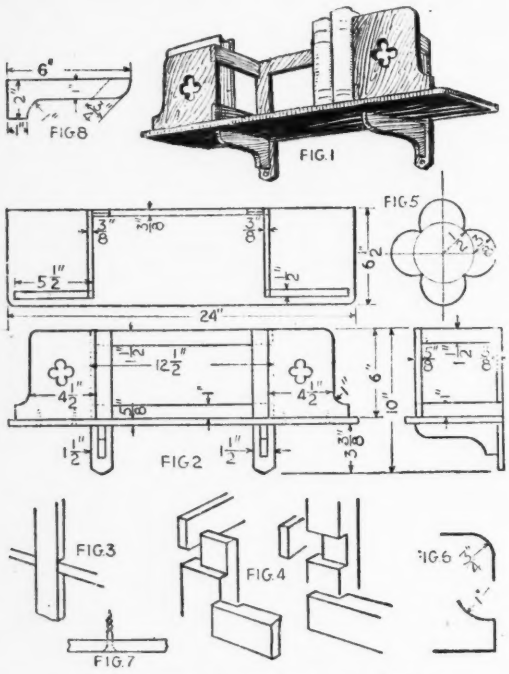
WHILE almost any kind of wood can be used in the making of this book shelf, it is well to select the kind of wood that will match with other pieces of furniture, or the finish of the room. If made of the same wood as the doors and casings it will have a "built-in" appearance and there will be no abrupt contrast with articles of furniture. The finished shelf is shown in Fig. 1. The material list is as follows:

1 base, 2 ft. long, 6½ in. wide and ⅝ in. thick
2 facing pieces, 6 in. long, 5½ in. wide and ½ in. thick
1 top back rail, 12½ in. long 1½ in. wide and ⅜ in. thick
1 bottom back rail, 12½ in. long, 1 in. wide and ⅜ in. thick
2 top end rails, 6 in. long, 1½ in. wide and ⅜ in. thick
2 bottom end rails, 6 in. long, 1 in. wide and ⅜ in. thick
2 back uprights, 10 in. long, 1½ in. wide and ⅜ in. thick
2 brackets, 6 in. long, 2 in. wide and ½ in. thick

To start the work, begin with the base, the plan of which is shown in Fig. 2. If the material is purchased from a mill the pieces can be ordered cut to dimensions, planed and sanded, which will cover most of the hard work. The outside corners of the base are slightly rounded as shown. The bracket pieces and the back uprights are next in order of construction. The lower ends of the uprights are cut pointed and set in the back edge of the base as shown in Fig. 3. The joints for the rails are shown in Fig. 4.

The facing pieces have an ornamental

opening cut in them. It consists merely of four circles cut out as shown in Fig. 5. These may be drawn with an ordinary pair of compasses. The outside edges of



Details and dimensions of a bookcase and shelf for a small clock

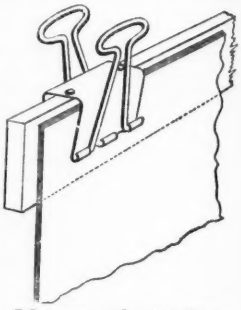
these pieces have their upper corners rounded and the bottom part cut out to form a projection that gives it a pleasing appearance. These shapes are drawn as designated in Fig. 6. They are then fastened to the base with screws, Fig. 7.

The brackets are shaped as shown in Fig. 8. These are fastened to the underside of the base with screws, as are also the back uprights. It is best to give the surface of all joints a good coat of glue before turning in the screws. It is necessary to bore a hole before driving a screw in cabinet work. This may take a little time but it saves a great deal of trouble in the end.

The central division may also be used as a place for a small clock.—H. ADLON.

Paper Clips with a Stick Used for Paper File

THERE is now on the market a simple spring steel clip that renders it a very simple matter to contrive a satisfactory file for newspapers, blueprints or drawings. Three clips are necessary, and these are attached at the center and at each end of a slender stick of the required length. The latter should preferably be of oak about 3/16 in. by 1 in. Each clip is held in place by means of two small wire nails driven in through holes punched near the ends of the clips, all as indicated in the accompanying illustration. When not in use, the small handles may be pushed flat against the sides, leaving one remaining up in the center so that the file may be hung up. The sheets may be filed on one or both sides of the center strip.—JOHN D. ADAMS.



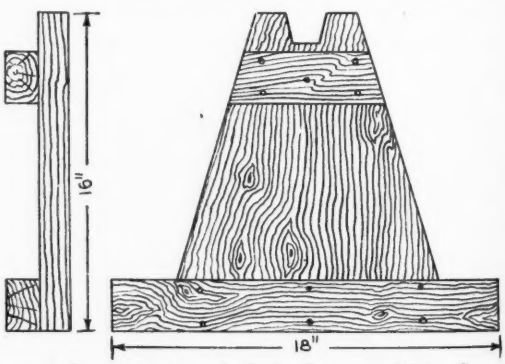
Manner of attaching clip on papers and stick

Goggles to Be Used When Making Chemical Experiments

A PAIR of motor-goggles with windows of mica rather than glass, afford valuable protection to the eyes when experimenting in a chemical laboratory. A pair should be kept handy for use when operating with flasks and tubes of boiling liquids that are apt to decrepitate and spurt. The most comfortable to wear are those with large windows having an edging of chenille or velvet.—H. J. GRAY.

To Keep Weight of Automobile from Tires

THE upkeep of tires is the greatest expense of an automobile, but with the



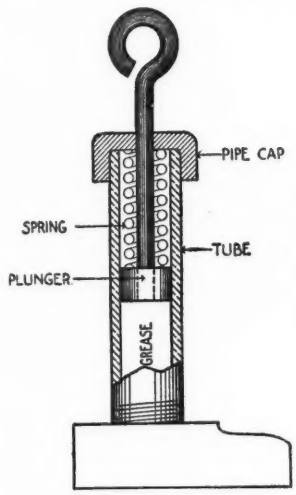
Axle support or jack to keep weight of automobile from tires when not in use

jack illustrated the weight of the car is held off the tires, so that the wear on them

is greatly reduced. These jacks are easily made and they are inexpensive to build. The size of the jack given is for a 30-in. wheel. For larger wheels the height should be 2 in. more than the height from the hub to the floor.—A. R. COLBURN.

A Lubricator for Automobile Steering Pivots

THE accompanying sketch shows a simple self-feeding grease-cup which any mechanic can assemble without difficulty. This cup may be applied without any alterations to the automobile axle. It consists of a brass tube threaded at both ends and of the proper size for the pipe thread in the tapped hole of the axle. One end screws into the axle, and on the other end a pipe cap with a hole in it for the plunger rod is fitted. The plunger and rod with a light compression-spring are assembled as shown. This spring should not be too strong lest the grease be forced out of the bearing and wasted.



A grease-cup made of a pipe and pipe-cap

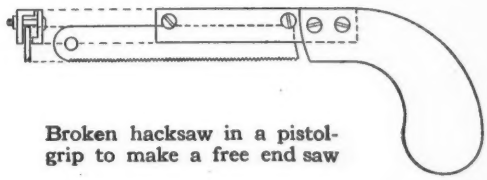
The proper size spring will make this lubricator far more economical than the compression type of grease-cup. The height of the plunger above the cap indicates the amount of grease which is in the tube.—W. BURR BENNETT.

A Soda Mixture for Quickly Removing Varnish

A GOOD varnish remover can be made as follows: To three quarts of lukewarm water, add one quart of good caustic soda. When thoroughly dissolved, apply with a coarse sponge. This is much better than using oil because varnish should not be applied on an oily surface. If oil is used, it should be thoroughly rubbed out with soapy water and dried with turpentine or alcohol.—L. E. FETTER.

A Free End Hacksaw-Blade for Difficult Work

A VERY handy hacksaw useful in repair work is one having a free end. Such a saw can be made from a broken

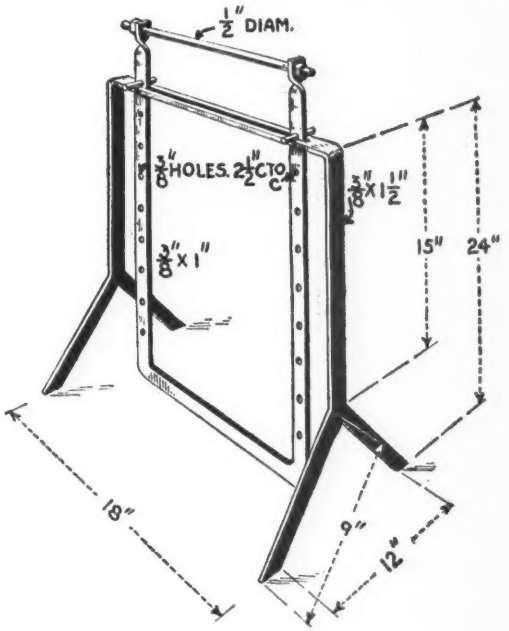


Broken hacksaw in a pistol-grip to make a free end saw

blade clamped in a pistol-grip handle, as shown in the illustration. The clamp part consists of two L-shaped pieces held together with bolts.—JOHN W. SHANK.

An Adjustable Stand Helper for the Blacksmith Shop

THE usual standard form of helpers with one leg seldom gives perfect satisfaction as it is so likely to topple over when the work is pulled or pushed over the anvil. The illustration shows a different type of a helper in which there are two standards, each with two feet, making it very substantial and firm. The



A helper for the blacksmith shop that will not topple over with the work

material used consists entirely of ordinary stake iron with dimensions as shown.

An Inexpensive Method of Coloring Electric Globes

THIN a small portion of white shellac with alcohol—a sufficient quantity to cover the globe when it is dipped into the liquid. Dipping the bulb into the solution applies a coating that is a good substitute for frosted glass. To apply an even coat it is necessary to have the shellac very thin. If it is desired to have colored globes, procure some egg dye of the desired tint, dissolve it in alcohol and mix into the shellac.—GEORGE YASTE.

Truck for Handling Filled Sacks on Stairways

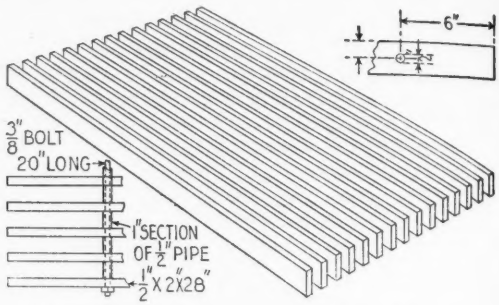
ORDINARY trucks are not suitable for use on stairways. The truck shown was originally devised to remove a number of sacks filled with fancy potatoes from rooms in a basement, but it has enough merit to recommend it for general purposes. It is made up of two handles, two runners

Instead of wheels two runners with both ends curved are used in the manner of a truck

and three braces as shown. It can be pushed over a floor and pulled up a stairway, preventing the wearing of the sacks or the bruising of their contents. The floor and stairway in this case were of concrete.—EDWARD R. SMITH.

How to Construct a Door-Mat of Wood Slats

A GOOD substantial door-mat and shoe-scraper that can be very easily and quickly made is shown in the illustration. The crossbars are made from a number of



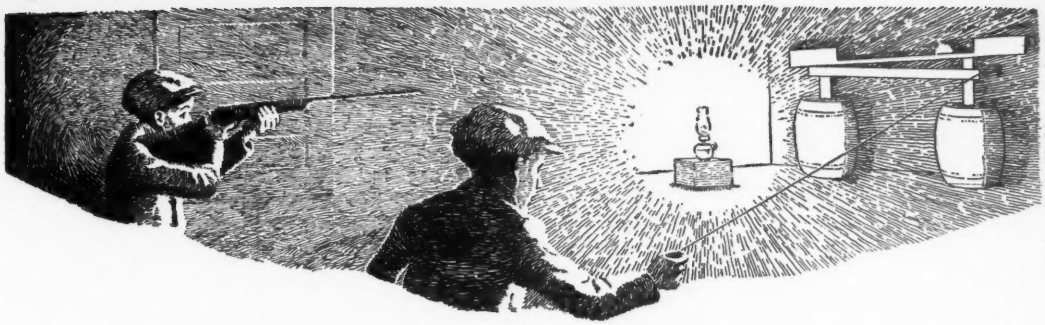
The wood bars are spaced for catching the mud and dirt as it is scraped from the shoes

½ by 2-in. iron rods of any desired length and number. Each bar is drilled 6 in. from the end with a ½-in. drill. Two iron bolts of sufficient length must be obtained and also a supply of 1-in. sections of ½-in. pipe to be used as separators for spacing the bars. The bolts are inserted in one bar; then a 1-in. section of the pipe, then another bar, and so on, until it is complete. If the nuts are not drawn up tight so that the bars are allowed to move ¼ or ⅛ in., they will take off the mud much better, because they will tilt whenever the shoe is drawn across the mat.—FRANCIS W. NUENMACHER.

Oxidizing Iron with Fumes from Acids

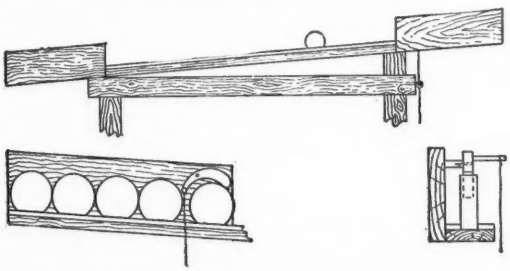
VERY pleasing and durable color effects can be obtained upon the surface of iron articles by oxidizing with the vapor of acids. Having thoroughly cleaned the metal, removing all traces of grease and polishing it highly, heat it and expose it to the vapors given off by a mixture of nitric and hydrochloric acids in equal proportions. When a good bronze color is obtained allow the article to cool, then coat it with vaseline and heat it again.

A wide range of colors can be produced after a few trials, ranging from pale primrose to deep brown or red. This is done by varying the proportions of the acids and by adding other ingredients—acetic and sulphuric acids. If the disengagement of vapor is too slow the acid mixture may be warmed.—H. J. GRAY.



Moving Targets for a Home Shooting Gallery

THE moving targets, now so common in shooting galleries, are entirely out of the question for home practice, owing to the cost of the machinery and its bulky nature; however, the same results can be obtained with the device illustrated, which is not expensive or difficult to construct. It consists of a board placed on a slant on two posts. On this board the moving objects roll. These are made of plaster formed in tin-can covers. To prevent the disks from rolling off the board, strips are nailed on as shown to make a groove for them. At both the upper and lower end, facing boards are fastened so that the marksman cannot see the disks until they start rolling.

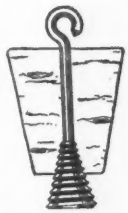


Details of the moving target-stand and the trap used for releasing one disk at a time

A number of disks are set in the groove at the upper end and one disk is released at a time by a trigger operated with a string. The speed of the rolling disks is governed by the slope.—G. P. LEHMANN.

An Expanding Bolt for a Bottle Stopper

AN expanding bottle stopper can be made with an ordinary rubber or a cork stopper and a bolt of the usual expansion type. The threaded end of an iron screw is set in a mold and lead or babbitt metal run in about it. The mold is made to cast a conical slug having threaded sides. The opposite end of the screw is forced through a cork or rubber stopper and bent into a circle, as indicated in the drawing. When a cork is too small to fit a bottle, the screw is turned and the expansion slug forces out the sides. The cork is removed by unscrewing the slug. Such a device can be used only on bottles which do not contain acids; for the acids would destroy the metal screw.



Conical screw to expand bottle stopper

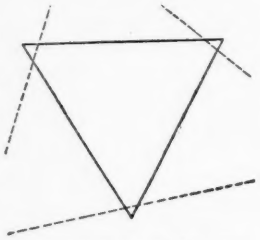
Sponsons for Motor Boat or Motor Canoe

EVERY one who has run a motor canoe or boat against a head wind must have noticed how the spray will come aboard and make things unpleasant. The following device is one I have used for a number of years with great success, and it is also of great value for fenders when running alongside a pier or landing stage. Procure from a garage two old inner tubes both the same length and size. Cut them at one point and cement the ends, or, better still, have them vulcanized. I cemented mine but I found that it was necessary to put wooden clamps on each end to keep them from coming apart.

Make two snug canvas covers of 8 oz. duck. These can be easily made on the sewing machine. With a little manipulation the tubes can be drawn through the covers. Make a hole in the cover for the valve. The tubes are then blown up and either lashed or strapped to the gunnel of the canoe starting from the bow. Besides warding off the spray they will also help considerably in case of an upset as the air they contain would keep the boat or canoe from sinking. —B. E. DOBREE.

Making a Reamer from an Old Three Cornered File

WHEN in need of a reamer in the workshop one that is very serviceable in an emergency can be made from an old three-cornered or a square file. Grind the faces until they are smooth; then grind the edges, as shown by the dotted lines in the accompanying drawing, so as to form good cutting edges. Fit a handle to the tang and the reamer is complete.

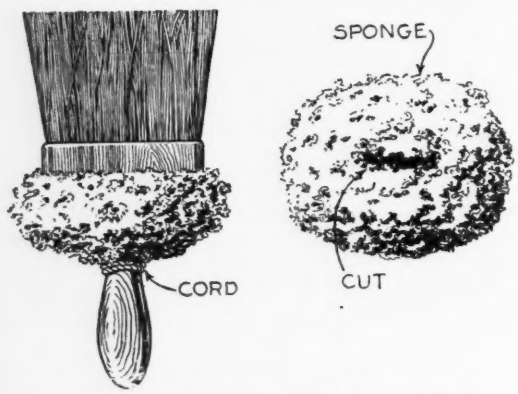


Corners ground off of a file for cutting edges

When using a large file for a reamer it may be found hard to turn, in which case a small pipe-wrench may be used to good advantage.—JOSEPH STATLER.

A Successful Anti-Leak Device for Paint Brushes

THE best method I have ever seen employed for preventing the color or wash from running down over the handle of a large brush when overhead work is being done, is to use a sponge attachment as shown in the illustration. Take a good, large sponge, oblong in shape, if possible,



Sponge on brush handle to take up color leakage. It can be wrung out on the brush

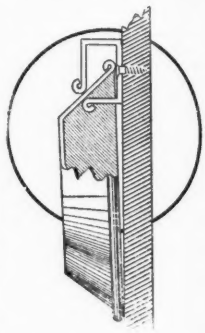
and cut a large slit in it to allow it to slip over the brush handle. Push it up as far as it will go and tie a cord on the handle to prevent it from slipping back. The sponge will take care of all the leaking color, and it can be wrung out at any time while on the brush.—JAMES M. KANE.

Replacing Old Valve-Stems in Automobile Tires

THE most satisfactory results can be obtained by forcing the old valve-stem back inside the tube and cutting a small hole about 1 ft. from the valve-hole, through which to draw it out. Insert the new valve-stem through the new hole, vulcanizing the hole shut, and bring the new valve up through the original valve-hole. This prevents the fabric in the valve-patch from being ruptured and strained, and will always hold the valve-stem secure.

A One-Piece Hanger for a Flaring Pie Tin

THE accompanying sketch illustrates a form of hanger for pans, especially those not having ears or handles. The hanger is formed from a narrow strip of metal, bent into the form of a rectangle, except that it is left open at the lower left corner, and the ends are curved backward. At the opposite side from this opening, midway between the extremities of the hanger, a hole may be either drilled or punched, to receive a nail or screw, by which it may be attached to a wall.



Having placed the hanger upon a wall, it is only necessary to introduce the lip of a pan between the downwardly and horizontally extending pieces of the hanger and allow the pan to fall against the wall. The pan will rest up in the horizontally extending part.—C. NIELSEN.

A Quick Way to Level the Legs of a Table

SOMETIMES one leg of a small table is a trifle shorter than the others, which causes a rocking motion when the table is touched. The difference in length may be so small that sawing the others would be a tedious job, and possibly unsatisfactory; but the trouble can be remedied by driving a short large-headed nail like a roofing nail into the short leg. Drive the nail up almost to the head, until the proper length is added to the leg.

PLANS FOR SMOKE HOUSES

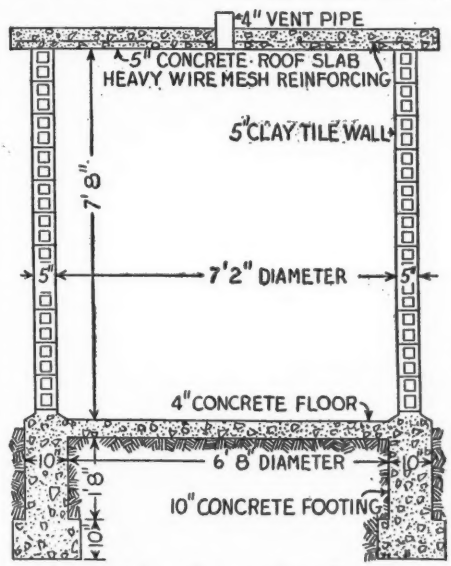
By W. E. Frudden

THE outside diameter of the round house illustrated is 8 ft., and the height is 8 ft. The unique feature is in the use of silo blocks made of clay tile to obtain the shape. These blocks will make a 5-in. wall. The tiles are laid upon a concrete foundation that is set into the earth 2½ ft., and is 10 in. thick. A 1—3—5 mixture of cement, sand and gravel is the proper one to use for the foundation and for the 4-in. floor.

The mortar for laying up the tile is made of 1 part cement to 3 parts sand. If the house is built in dry weather the blocks should be soaked in water before laying them. If this precaution is not taken the porous structure of the tiles will take up the moisture in the mortar and weaken its holding qualities.

It is not difficult to lay the tiles, but remember to keep them true and plumb at all times and test the wall frequently with a plumb and level during erection.

The roof consists of a concrete slab reinforced with heavy wire mesh. The ordinary mesh wire used for making a fence for hogs will answer the purpose. It may be made on any level platform, or a barn floor. To make the slab 5 in. thick and about 9 ft. in diameter, 1 sack of cement, 2 cu. ft. of sand and 3 cu. ft. of gravel will be required. The wire mesh is laid on a layer of concrete 1 in. thick, then the remaining concrete is put on and tamped. The round shape of the edge can be made by means of thin boards bent to the circle, or a strip of sheet metal that is 5 in. wide.



An elevation of a round smokehouse constructed of silo blocks of clay tile set on a concrete foundation

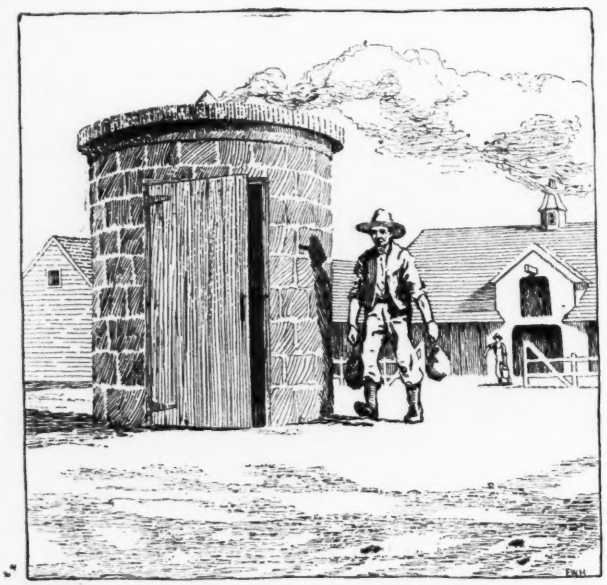
The door for the structure is the only opening in the walls. The door-frame is made of 2 by 6-in. planks, strongly fastened together and bonded to the walls. The bonding may be accomplished by driving large spikes through the frame material and into the mortar joints. The materials necessary for the house are as follows:

5½ barrels of cement
130 hollow clay building tiles, 5 by 8 by 12 in.
60 sq. ft. of wire mesh
1 door frame, 2½ ft. wide and 7 ft. long
1 door

The square house is a little more difficult to build. However, the added feature of an outside fire box is sufficient recompense for the extra time and expense in the construction. The building is square with 8-ft. sides and an 8-ft. wall. Concrete blocks instead of the tile blocks are used for the walls, the foundation and the floor being about the same as for the round house except in shape. The materials necessary for the construction of this house are, 24 sacks of cement, 3 yards

of sand, 5 yards of gravel and 200 concrete blocks.

The roof for this house is one concrete slab. No doubt this can best be constructed by making a form within the building of the desired shape and putting on the concrete the same as was done in making the other one on the barn floor. It will require some ingenuity to make a form for the edge, however. Nail boards together in an L-shape, making four pairs of them and forming a huge frame around the upper part of the blocks of the wall and properly supporting it, to form the proper eave for the roof.

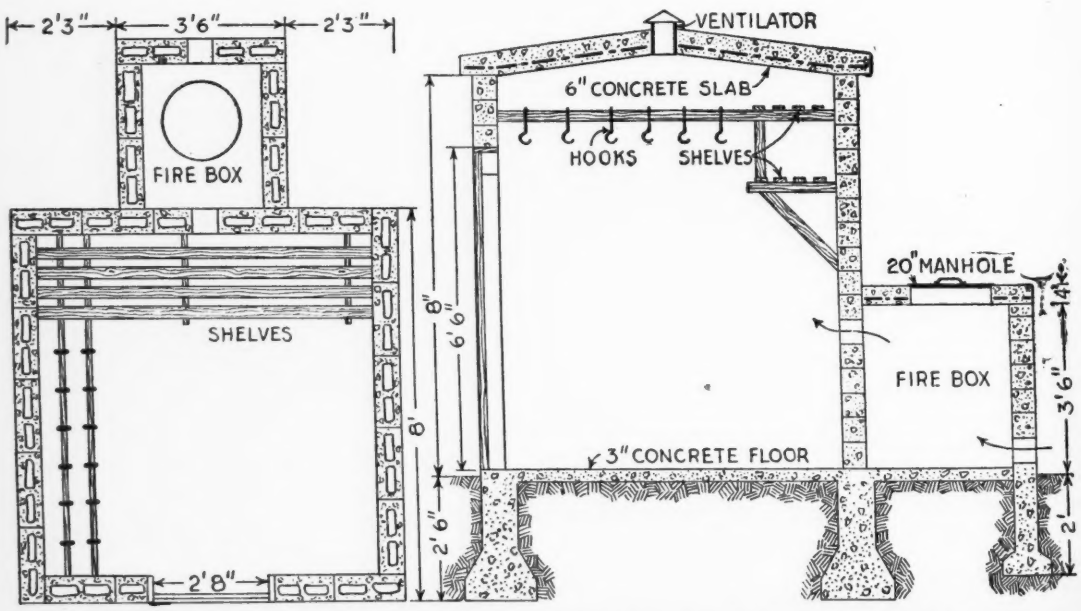


The curve of the walls of this house is obtained by using shaped silo tiles. It is covered with a concrete slab

For either house, use ventilators in the center of the roof slab. These should be put in when making the slab.

Shoring up a Porch-Post to Repair Floor-Boards

HAVING to repair some floor boards under and about a porch-post it was necessary to shore up the post. This is the method I used. I first laid a piece of 2-in. plank about 8 in. wide on the ground and with a similar plank a trifle longer than the distance to the plate of the porch, I made a slanting brace or support. With an iron bar having a flattened end I raised the post up a little at a time by lifting on the end of the plank and pushing it to a more vertical position. This was not much of a job, but the post was raised and the work was satisfactorily completed without a jack.—A. A. KELLY.

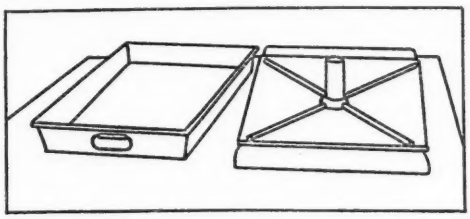


Plan and elevation of a square smokehouse having an outside firebox, all made of concrete hollow blocks set on a concrete foundation with a concrete floor

An Easily Constructed Pan for Sterilizing Dairy Utensils

WHEN dairy utensils are sterilized by steam all bacteria and disease germs which may be upon them are destroyed and, therefore, milk and cream when placed in these utensils will keep much longer.

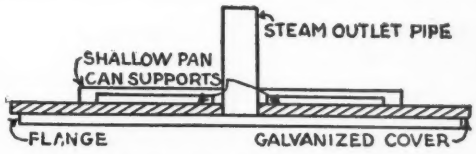
A very efficient and inexpensive steam-sterilizing plant for the small dairy can be made as follows: An ordinary roasting-pan 20 in. long, 14 in. wide, top measurement, and 3 in. deep, is used for the steam generator. The cover is in three parts; the lower part, fitting closely over the pan, is covered with asbestos, upon which is placed the upper part, the latter being the same width as the pan, but 3 in. shorter at each end. It is made as follows: A sheet of heavy galvanized iron is cut large enough to cover the top of the roasting pan, allowing a little to overlap the edge. Flanges are soldered beneath this cover so that they will meet the edge of the pan,



The parts of the sterilizer for the dairy, made with a roasting pan as a base

thus making a tight cover. A hole is cut in the center of the cover 1½ in. in diameter and a round galvanized-iron pipe 4½ in. in height and 1½ in. in diameter is soldered in it. The cover should then be insulated by covering with a piece of asbestos board 5/16 in. thick. A hole is cut in the center of this piece to allow the steam-outlet pipe to pass through. Then for the upper part make a shallow pan of galvanized iron 14 in. square with sides ⅝ in. high. Cut a hole 1½ in. in diameter and fit the pan on top of the asbestos, allowing the steam-outlet pipe to extend through the center hole. When the pan is pressed down close to the asbestos, solder it to the steam-outlet pipe which passes through it. Four strips of stiff galvanized iron ⅜ in. wide are soldered to the pan. These should extend ⅜ in. above the bottom of the pan and should run from a distance of 1 in. from the corners to 1 in. from the steam-outlet in the center. A section through the cover is illustrated.

In case asbestos cannot be obtained, paper may be used instead. Pack the papers tight to a thickness of ⅜ in. over galvanized iron and cover with another iron sheet, soldering all edges together to

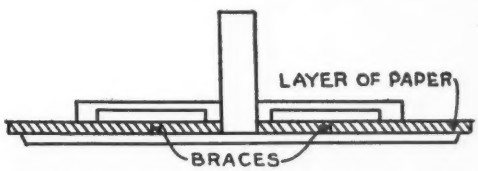


Section through the cover of the roasting pan showing asbestos board used for insulation

make absolutely tight seams. This will form an insulated cover ⅜ in. thick to take the place of the asbestos. The construction of both covers is very similar.

The other part of the sterilizer consists of a galvanized-iron box with a removable cover, which has a handle on the top. This box has no bottom. The 14-in. shallow pan on the asbestos over the cover of the roasting-pan forms the base of the box. The sides should be made separate, 11 in. high. These should fit tightly in the shallow pan. On one side of the box at the top a wire should be attached, ¾ in. from the top and ½ in. from the side. The cover for the box should be made large enough to extend over the sides and fit closely. A two-burner wickless kerosene stove will give excellent results for a heater.

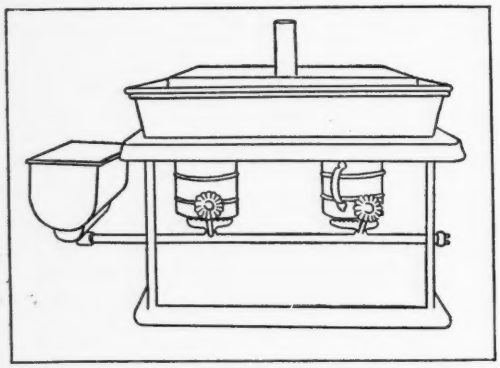
Sterilization is not a substitute for washing. All utensils should be rinsed in cold water, then washed thoroughly with hot water and washing powder so that they are well cleaned before sterilization. Water at the depth of 1 in. in the pan will furnish steam at a temperature of 211 deg. F. for about 50 minutes. If the sterilizer is operated for a long period, water should be



The same construction of a cover for the sterilizer with paper used instead of asbestos

added to make up for loss by evaporation. The temperature of the steam as it comes from the outlet pipe must be at least 295 deg. F. and preferably 210 to 211 deg. Cans, pails, covers, and strainer-cloths must be steamed for fully 5 minutes. Longer steaming will do no harm, but it is

not necessary. The 5-minute period must be reckoned from the time the can is placed inverted over the steam outlet, and the steam must be at least 205 deg. F. when the can is placed in position. An



Sterilizer on a two-burner kerosene stove with can in position for sterilizing utensils

aceurate thermometer, with a scale reading to 212 deg. is necessary.

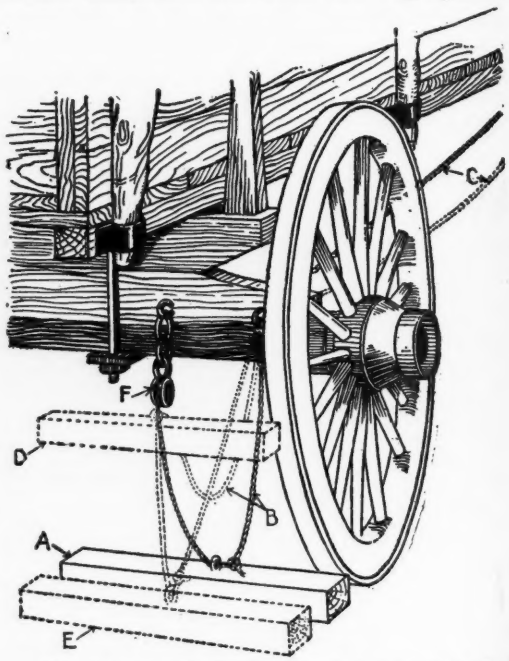
Repairing Gasoline Pipe with Oiled Paper

SOME time ago I took my long-used motorcycle and started out for a day of pleasure, supposedly. I had my rifle and a lunch with me. When riding over a particularly bad stretch of rocky road, I took a "spill," but soon picked myself up, only to find the oil running from the tank. My machine not being equipped with footboards, the small oil-pipe running from the tank to the pump was exposed and this pipe had been so badly damaged by the "spill" that it was broken in two places. Stopping the flowing oil with a small plug, I decided that I was to enjoy a 6-mile walk to town. After some thinking I took some of the wax-paper wrapped around my lunch and started to piece out the broken space. I rolled the paper tightly around the ends of the pipe and wrapped it with a small roll of insulating tape which I had with me. After the motor was run a few seconds to suck the air out of the pipe, the oil started to circulate and I was able to get home without walking.—DUNCAN DILLON.

A Practical Wagon Trig Operated from Driver's Seat

THE device illustrated is a substitute for a wagon brake and consists of a hard wood trig *A*, not larger than 3 in. square and about 30 in. long, which is operated by two ropes, *B* and *C*. These are fastened to a screweye or staple so placed that the trig will balance as at *D*. The rope *B* should be fastened to the rear axle as near the wheel as possible, and have such a length that the trig will drag upon the ground a few inches behind the wheel as at *E*, when the wagon is moving forward. It will drag at right angles with the direction in which the wagon is moving unless it strikes some obstacle which gives it a different angle, when the trig will automatically resume its correct position as soon as the obstruction is passed.

If it is necessary to back the wagon, or when it is upon a down grade or level ground the trig may be hoisted clear of the road by rope *C*, as at *D*; this rope passes through a pulley at *F* to the front of the wagon where it can be easily reached by the driver. When the rope is released the trig will at once fall into its place behind the rear wheel as the wagon moves ahead. When the horses stop to rest the wagon will settle back until it rests upon the trig which will be so far under the rear wheel that the downward pressure as the wheel settles backward will force the trig against



The trig as it is fastened to the rear axle of a wagon and operated with a rope from seat

the ground; this prevents the trig from turning or slipping back and gives it a good grip.—CHARLES A. KING.

Using the Automobile Jack to Straighten a Frame

IN machine shops employes are often forced to rig up all sorts of make-shift arrangements for unusual jobs. One of

An "old man" arrangement used with an ordinary jack to straighten a chassis frame

these is shown in the accompanying illustration, which depicts a helper straightening a bent side-frame member of a large automobile by means of an ordinary ratchet-jack. The manner in which the work is done can be clearly seen in the illustration.

Celluloid Makes a Superior Stencil Cutting Base

WHILE cutting out a stencil, I picked up a celluloid triangle to use as a base. I found it to be superior to wood or glass for the purpose, as wood has ofttimes hard streaks that resist the smooth progress of the knife, and glass will dull the blade. Celluloid is even in composition and allows the knife blade to penetrate it just far enough to leave the cut without any projecting edge.—JAMES M. KANE.

Making a Handy Pencil-Holder of a Board

TAKE a board 8 in. long, 5 in. wide and 1 in. thick and saw it diagonally from one corner to its opposite, making two triangles of it. Into the side of one, bore ⅜-in. holes spaced about ¼ in. apart to within ½ in. of the bottom, using the 8-in. way as the base. Secure this in a convenient place on the work-bench. It will hold almost any length of pencil.

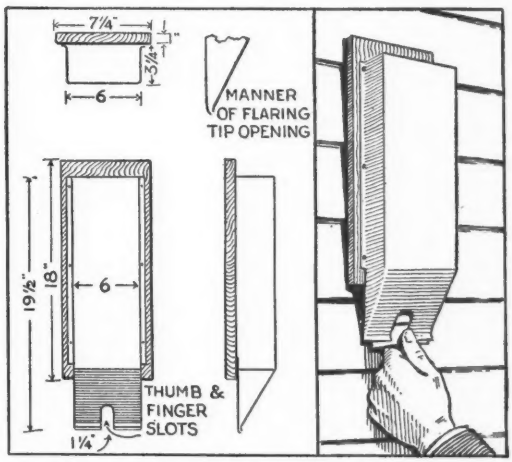
Sheet Metal as a Substitute for a Small Nut

THE loss of a small slotted nut on light machinery, such as that of a motorcycle, automobile or motorboat means a stop until a duplicate may be had. Parts of this nature are not easily found, but a substitute may be formed of sheet metal or a piece of tin, which may be obtained from a tobacco or a fruit can. A piece of the metal is folded over back and forth five or six times, then the folds are punctured with a nail or punch. Each separate layer is worked over the thread as shown. When this substitute is turned up tight, it will not work loose like the ordinary nut.—RONALD F. RIOLET.

Nut made of a tin strip

A Convenient Tag-Holder for the Shipping-Room

THE illustration shows the details of a very handy and convenient shipping tag-holder. A number of tags are dropped into it the long way. As a result of the bend and flare at the end it is impossible for more than one card or tag to be thumbed out at one time. A number of these were put up in a shipping department of a shop. The arrangement was soon recognized as very convenient by the billing and shipping

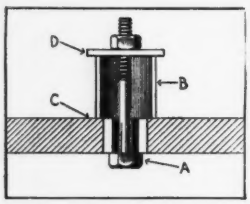


Holder for shipping-tags to keep them arranged so that one can be taken out at a time

clerks, who, before its installation, were always losing time and temper securing tags.—F. W. BENTLEY.

Removing Small Bronze Bushings That Have Become Worn

IN certain machines it is necessary at times to remove bronze bushings which have become worn and are so located that it is impossible to drive them out. Chipping takes too much time. The sketch shows a method which is very easily applied in such cases. A bolt of sufficient length, *A*, is used through the bushing and a piece of pipe *B* is placed as shown. The length of the pipe should be equal to the thickness of the part, *C;* the diameter of the pipe should be a little larger than the outside diameter of the bushing.



Drawing a bronze bushing with bolt

A large washer or a short piece of bar iron may be used at *D*. The head of the bolt should be slightly smaller than the outside diameter of the bushing; then by turning the nut the bushing is easily removed.—J. P. HARNER.

Drawing a Nail Easily After Striking It a Blow with a Hammer

A NAIL not driven entirely in and which has become so rusted that it cannot be withdrawn without breaking a hammer handle, will come out easily if it is struck a smart blow first. The same holds true with a screw; if it will not turn out, try turning it in first. These suggestion may not always work, but many times the trouble may be overcome by their use.

Smooth Tone Phonograph Diaphragm Made of Telephone Transmitter

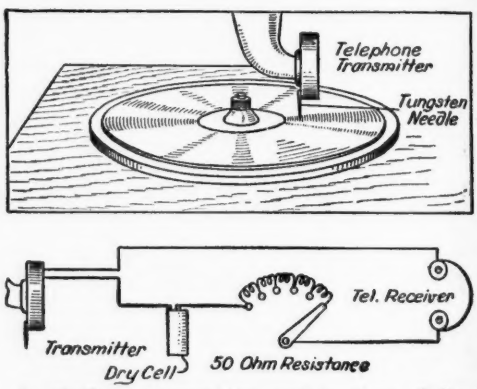
AN electric attachment for the ordinary phonograph or victrola can be used with pleasing results in place of the diaphragm sound reproducer and horn. It is necessary to unscrew the diaphragm from the swivel and substitute in its place a small, light telephone transmitter from which the rubber mouthpiece has been removed. The transmitter can be held in place by wires or a removable clamp. To one of the sides of the transmitter a tungsten needle is soldered. Ordinary soft tone or loud tone steel needles can be used, but they have to be replaced so frequently that the task becomes tedious.

The weight of the transmitter may be regulated with small rings of lead. The needle should bear upon the phonograph cylinder surface with the same pressure as is exerted when it is used ordinarily.

Small flexible silk-covered lamp cord should be connected with the terminals of the transmitter, and led to the back of the phonograph and to a battery and a telephone receiver. Sensitive receivers are not necessary. It is advisable to use double receivers fitted with a head band. One fresh cell of the dry battery type will be sufficient. The proper connections are shown in the accompanying diagram. A fifty-ohm variable resistance should be inserted somewhere in the circuit.

When the phonograph is started, the notes of music will be heard in the telephone receivers with perfect clearness, the usual scratching sound being almost entirely eliminated. By adjusting the resistance box the tones can be made loud or soft at will. If the record is old and badly scratched, the customary grating noise can be "tuned" completely out by adjusting the rheostat.

The explanation of the operation of this device is that, contrary to the usual graphophone sound-enlarging arrangement, the electric system does away almost entirely with sound distortion. It is impossible to construct a phonograph horn which will not distort the sound. On short distance telephone systems, if they are properly constructed, the distortion of the sound is hardly appreciable. The sounds which emerge from the receivers when the transmitter is used with a phonograph record are consequently nearly pure. The music sounds as if it comes from a distance, almost resembling the sound of music coming across the water.



A telephone transmitter used in place of the sound-producing diaphragm of a phonograph

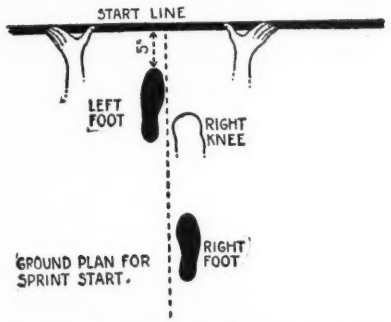
Winning an Athlete's Laurels

I—Running, hurdling and relay races

By Albert B. Wegener

A technical instructor and director of athletics of twenty-seven years' experience

SPRINTS, or dashes, are short races up to and including a quarter mile (440 yd.) run at top speed all the way. Sprints are perhaps the most popular of athletic events and success depends mostly upon nerve reaction, since athletes of all sizes and build are among record holders.



Ground plan for placing the feet, knees and hands to make the start for a sprint

It is customary for four to six athletes to run at a time, the first four belonging to the first "heat," the second four to the second heat, etc., until all have run. Then the first two of each heat run additional heats, called "semifinals," after which the first and second of the semifinals run in the final heat. Before the meet the games committee draw the runners' names by lot to determine which ones are to be in each heat. These positions are published on the program and cannot be altered even though only one man appears to run in a heat.

The starter oversees the drawing for the places and the clerk lines them up.

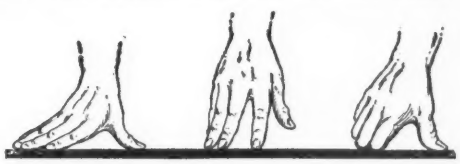
The runners then dig holes in the track for their feet, the holes being 3 or 4 in. deep with a firm perpendicular back wall. The front hole is dug for the left foot from 4 to 6 in. back of the starting line (sometimes called "scratch"). The rear hole for the right foot is dug a little to the right and far enough back so that when in a kneeling position the right knee comes almost to the front hole.

At the starter's command, "Get ready," or "On your marks," place your left foot in the front hole, kneel on the right knee, place the right toe in the rear hole, place the hands on the mark in an arched position with two spans distance between the thumbs. This is called the "crouch start" and is used by all good runners.

At the starter's command "Set," or "Get set," raise the right knee 6 in., or so that the lower leg is horizontal. Incline the weight forward on the hands and left leg, arms bent a little. Note that the shoulders are forward of the mark. Do not "crane the neck," but hold the head natural, eyes on the track about 20 ft. ahead. Contract all the muscles for the spring and hold a steady position. Do not "break" (start before the pistol is fired). This is a bad habit of novices, and is costly, since the starter will place you back for each offense.

At the report of the pistol spring forward, not upward, from both feet and hands, taking a short, quick jab step with the right foot a few inches ahead of the mark and a little to right. At the same time jerk the left arm forward and the right backward and up. The weight must be well forward and low, the upright position being gradually assumed at about the sixth or seventh stride.

During the run incline the head forward, the body forward and arched. Hold the arms half bent and use them directly forward and backward, the action being all in the shoulder and none in the elbow. Move the legs directly forward and do not allow the foot and knee to turn outward. Take long, fast strides and run on the balls of



Three ways of placing the hands on the starting line preparatory for a dash run

the feet (heels up). When the foot strikes the ground in front, the leg should be bent as little as possible; do not elevate the foot high in the rear. Never look around to see where the others are, but fix your eyes on the finish and your whole attention on your utmost effort. When about 20 yd. from the finish get a feeling of fright as though

running from death. It will help you make a strong finish.

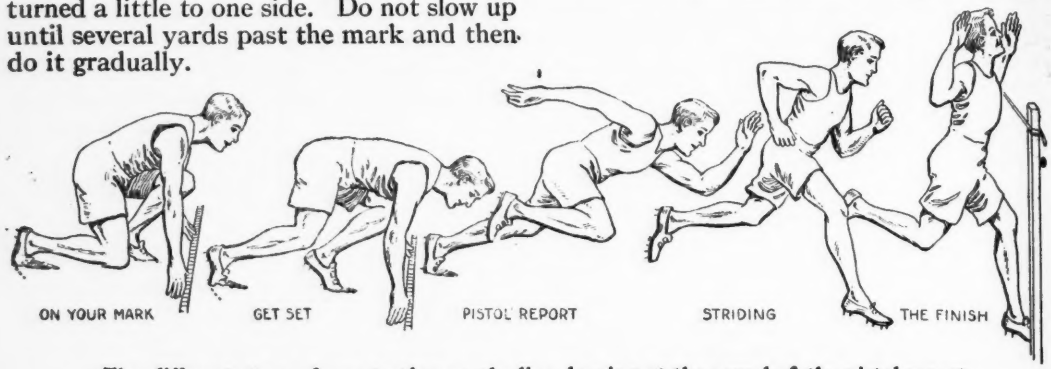
It is not possible for all runners to run at top speed in the quarter mile. Those who have little endurance should try to, but those who have great endurance may start a little slower and make a fast finish.

Never jump at the "tape" (finish yarn), but just before reaching it throw the arms forward up and half bent, chest forward and turned a little to one side. Do not slow up until several yards past the mark and then do it gradually.

a daily rub, kneading, and muscle stretching. Keep the muscles warm and if the weather is cool, wear a heavy robe and take slow preliminary warming-up work.

Distance Running

Distance runs are those of a half mile or more. Runs around the half mile mark are sometimes called "middle distance" and those of a mile and more "long distance;"



The different stages from starting on the line, leaving at the sound of the pistol report, running, and the finish in making a sprint or dash up to and including a quarter mile

Just before getting on the mark spend two minutes in deep breathing. At the command "Set" take a rather deep breath and hold it. At the pistol report suddenly eject the air and at the second stride take a quick deep breath through the mouth and hold it. In runs up to 50 yd. do not take another breath. In other distances do not use up all the air in the lungs before inhaling again. In the 100 yd. dash take a short breath at 50 yd. and another at 75 yd.

Spend plenty of time practicing the start and learn to hold the "Set" position on the mark. Become familiar with starting from the pistol report. After two or three weeks' preliminary exercise follow a daily schedule something like the following, if you are trying to get in condition for a 100-yd. dash.

Monday—Four or five starts. Jog 220 yd. with attention to stride and reach of the legs. Run 50 yd. at top speed.
Tuesday—Starts as above. Jog 440 yd. Run 100 yd. at about three-quarter speed.
Wednesday—Starts. Top speed 50 yd. Rest. Jog 220. 75 yd. at top speed.
Thursday—Starts. Jog 440 yd. Rest. Fast 150 yd. but not at top speed.
Friday—Starts. Jog 100 yd. 50 yd. top speed. Rest. 100 yd. top speed.
Saturday—Jog 220 yd. Rest. Three starts. Fast 75 yd.

Rest 2 or 3 days before a meet but take

but they are here considered together because they require about the same qualities. Lithe and long-legged runners are best adapted to distance running. The erect start is used instead of the crouch. This is done by toeing the scratch with one foot, the other being back one pace. There is no advantage in getting a quick start. Since the run is slow the chest and head are held erect, the arms swing rather wide forward and backward and a little bent. Some trainers have their distance runners swing their arms in continuous forward small circles that look like a "side wheel" action. All of the muscles should be held as relaxed as possible. Except in runs of five miles and more, run with the heels off the ground. In the longer distances it is necessary to vary this occasionally to relieve the leg muscles.

Special attention should be given to "striding." A long, regular stride is important. The front knee should be straight as the foot strikes the ground and that of the rear leg bent only moderately. The leg should not be swung forward stiffly, but should be allowed loose free joint play. Of course it is possible to overstride, and each runner must learn for himself the longest stride that he can maintain with the greatest ease.

An equally important matter is "pacing" (maintaining the same speed throughout

or for long stretches). Set the time in which you wish to run the distance and do your pacing with a watch so as to time each quarter, but be sure to have enough endurance left to finish with a dash of 100 yd. or more. Do not worry if an inexperienced runner passes you in the first part of the race and do not allow him to pull you into a faster pace. Almost always such runners drop out or fall far behind before the finish. Do not "set the pace" (take the lead) all the time unless your regular pace brings you far ahead of the others. If during the last part of a race a better runner passes you try to follow close behind if you are feeling well.

It requires years of regular practice to become a good distance runner and no one should attempt to run even a middle distance race without at least a month of careful training. Longer distances require more time. Coaches in small schools and clubs often beg members to go into a race "to fill out," even when they have had no training, but this should never be done in distance runs. Before starting to train for long runs get a medical examination and occasionally thereafter. No growing boy should train for long races. Jogging gradually up to a mile or two is good practice, but not for boys below fifteen or sixteen. Regular and good habits are necessary, as well as a good digestion, plenty of common food, and a careful watching of the weight.

Proper foot-wear is important. A soft, light, laced shoe with firm but flexible sole and low heel, snug-fitting, but not tight, with light woolen socks should be worn. Rub the feet daily with alcohol and if they become sore rest until they are well. Bathing in alum water is good for excessive perspiration. On cinder tracks spiked shoes may be worn, but never on hard tracks, roads, or cross-country. Breathe through the nose as long as it is comfortable, but do not hesitate to breathe through the mouth if the nose breathing is not free and comfortable. In either case both inhalations and exhalations should be well controlled.

Training Tables

When first starting to train for a half mile run, jog a half mile every day for two weeks. Every other day run another half after a fifteen minutes' rest, then adopt a weekly schedule something like the following:

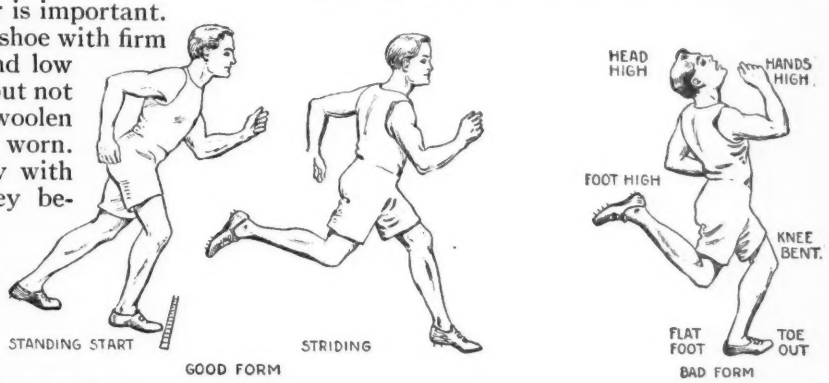
Monday—Jog three-quarters of a mile.
Tuesday—Run 600 yd. in fair time. Rest. Then do two 50-yd. sprints.
Wednesday—Run a mile at an easy gait.
Thursday—Run a half mile at a comfortable gait.
Friday—Practice sprinting altogether (half doz.)
Saturday—A half mile at a good gait.

Schedule for the Mile Run

Preliminary work for the half mile.
Monday—Three or four short dashes. Run a mile with a good pace for the first 100 yd.
Tuesday—Half a mile at good gait. Rest, then jog a half mile, sprinting the last 50 yd.
Wednesday—A little short sprinting. Rest, then jog a half mile giving attention to form.
Thursday—Fast 600 yd. Rest, then jog a mile; sprint the last 50 yd.
Friday—Short dashes. A mile at fair speed and sprint the last 100 yd.
Saturday—A mile at almost the best gait.
In racing, run the first quarter fast, slow down in the second and third, speed on last and sprint to finish.

Practice only three times a week for two-mile runs. Run an even pace and occasionally run a fast mile.

For ten-mile runs practice at four and five miles, and once a week at ten miles.



Toeing the line for a start and the striding form for distance running of a half mile or more. At the right a bad form of running

On alternate days practice a little light work, and massage. If weak, stop the practice and if not feeling well rest until you are better. Occasionally run more than ten miles. In a race the first half mile should be fast, but after that keep a steady pace.

Hurdle Races

Hurdles are light obstacles placed at regular intervals on the track over which the runners must leap during the race. The standard distances, heights, and number of hurdles are as follows:

In the 120-yd. hurdle race, each hurdle is 3 ft. 6 in. high and placed 10 yd. apart, with the first hurdle 15 yd. distant from the starting point, and the last hurdle 15 yd. before the finishing line. In the 220-yd. hurdle race 10 hurdles are used; each hurdle is 2 ft. 6 in. high. They are placed 20 yd. apart, with the first hurdle 20 yd. distant from the starting mark, and the last hurdle 20 yd. before the finishing line.

Front view of runner in good and bad form

In the 440-yd. hurdle race 10 hurdles are used, each hurdle being 3 ft. in height. The first hurdle is placed 40 yd. from the scratch mark, the remaining hurdles are placed 40 yd. apart, and the distance from the last hurdle to the finishing line is 40 yd.

In the 110-meter hurdle race there are 10 hurdles, each hurdle 1.06 meters (3 ft. 6 in.) high. The distance from the scratch mark to the first hurdle is 13.72 meters (15 yd.): the remaining hurdles are placed 9.14 meters (10 yd.) apart, and the distance from the last hurdle to the winning post is 14.02 meters (46 ft.).

In the 400-meter hurdle race, there are 10 flights of hurdles, each hurdle being 3 ft. in height. The first hurdle is placed 45 meters (49.213 yd.) from the scratch mark, the remaining hurdles are placed 35 meters (38.277 yd.) apart, and the distance from the last hurdle to the winning post is 40 meters (43.745 yd.).

In hurdle races of other distances, and with different numbers of hurdles, the hurdles should be placed at equal intervals, with the same distance between the first hurdle and the starting point and the last hurdle and the finishing line as between separate hurdles.

Since hurdling is merely modified sprinting, the rules of sprinting apply to it, except those distinctive features, "taking the hurdle" (leaping over) and striding.

The crouch start is the one used. The preliminary run to the first hurdle must be accurately made as in the high jump, so that there is no difficulty in making the leap. A take-off line should be marked on the track about 8 ft. in front of the first hurdle which the jumping foot must meet. Another mark should be made six or eight strides from the take-off line, which must also be stepped upon by the jumping foot. Some hurdlers find it necessary to start from the mark with the unusual leg forward so as to bring the stride out right.

In leaping over the hurdles always spring from the same foot. Bring the front foot well up forward, with the knee bent somewhat toward the chest but not turned outward. Bend the trunk forward upon the forward thigh. After the leap turn and bend the jumping leg horizontally outward and bring it forward steadily without a jerk, so as to be ready to stride when the forward foot strikes the ground. The arms are spread. Do not soar high, but get to the ground as quickly as possible. Do not twist the trunk, but keep faced to the front.

In the 120-yd. hurdles (called the high hurdles) tall men make the best records, since they can best make the three strides between hurdles. In the 220-yd. hurdles tall men take seven strides between hurdles and short ones nine. In longer distances there is no standard.

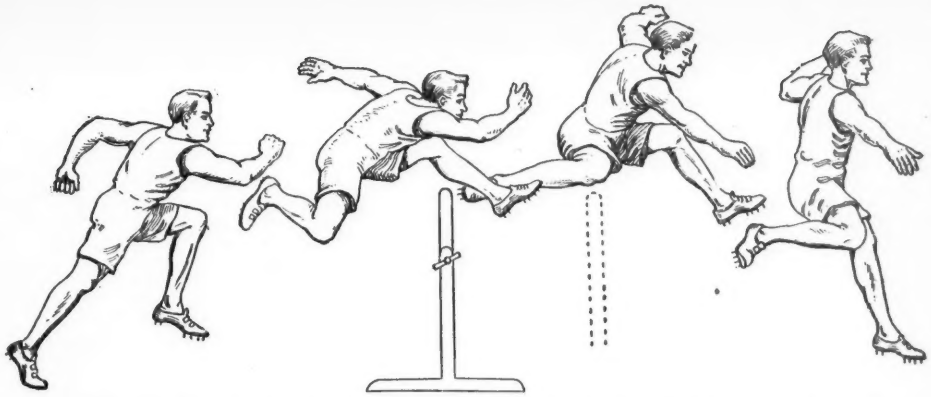
Rules

In making a record it is necessary for the competitor to jump over every hurdle in its proper position, and no record is allowed unless all the hurdles remain standing after the competitor clears them. A competitor knocking down three or more hurdles in a race, or any portion of a hurdle, is disqualified. In any championship race up to and including 300 yd., each competitor must have separate hurdles and a separate course marked out and measured independently, whether races are run straightaway or with turns.

Training Hints

Before starting regular hurdle practice, become hardened by several weeks of preliminary sprinting, jumping, and distance jogging as in training for sprinting. The daily schedule of practice work should be about as follows:

Monday—Take three starts. Set up two hurdles at proper distances and "take them"



Since hurdling is a modified form of sprinting the same rules apply to both with the exception of taking the hurdle and striding. The crouch start is the one used

at top speed. Rest. Sprint 100 yd. at fair speed. Rest. Jog a half mile.

Tuesday—Three starts. Take three or four hurdles at top speed, twice with rest between. Jog a half mile.

Wednesday—Three starts. Take six or seven hurdles at fair speed. Rest. Take three hurdles at top speed. Jog a half mile.

Thursday—Three starts. Two hurdles three or four times. Run full distance at moderate speed. Rest. Jog a half mile.

Friday—Three starts. Run 220 yd. at fair speed. Rest. Four hurdles at top speed. Jog a half mile.

Saturday—Three starts. Jog a quarter mile. Rest. Take the entire distance at top speed.

In training for longer hurdle races follow about the same schedule but increase the distances for the sprints and jogs.

Outdoor Relay Races

Relay races are those in which several runners, usually four, constitute a team, who run in succession over the required distance, each running an equal distance or otherwise as previously agreed upon, and either passing a stick from one to the other or touching him. The standard races for big athletic meets are:

1. One mile, each runs a quarter.
2. Mixed. The first runs a quarter, the second 220 yd., the third a half mile, and the last one mile.

Other distances may be selected to suit local conditions. A popular race is to have teams of ten or more, each of which runs 100 yd., or one lap (round) on a small track. This is an easy and safe way to pit small schools and clubs against each other. Relay races are sprints and the technic of sprinting applies, except that the first runner is the only one of the team who is allowed to take the crouch start.

The only distinctive feature is the "touch-off" (touching the next runner, or passing the stick to him). Each waiting runner takes his place near the back line of his starting zone and looks back at the approaching runner. When the oncoming runner is within five or six yards the next runner faces forward and starts to run, holding his right hand extended back with palm up to receive the baton (stick) from the left hand of the other. The distance and speed should be so timed that the transfer is made in the starting zone, each runner being at top speed.

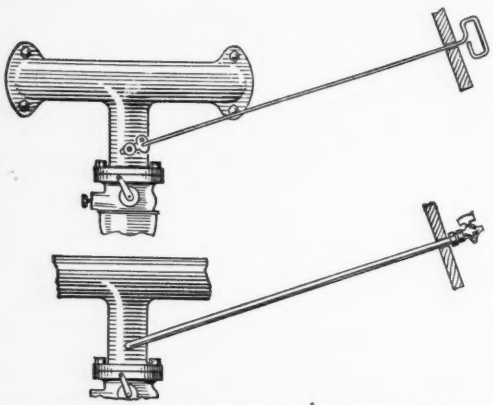
A line drawn 10 yd. on each side of the starting line of each relay is known as the starting zone. Within this zone each runner must pass the baton to the succeeding runner. No member of a relay team can run outside of such zone in order to relieve his team mate. The baton must be passed, not thrown or dropped by a competitor and picked up by the one succeeding him. Violation of any of these rules by any competitor disqualifies the team. No man can run two relays in any one team. The composition of a team cannot be changed after a trial heat has been run. No change can be made in the order of running, except in relay races where each competitor runs the same distance. The positions of the teams must be drawn. In all relay races an announcement must be made as to the distance each competitor is to run in his relay. Any competitor failing to run the distance required causes his team to be disqualified. In the case of a handicap relay race the runner on the first relay is allowed the total handicap allowed each team. Nothing is allowed the others.

(*To be continued*)

A Simply Constructed Vapor Plug for Automobile Engines

VAPOR plugs are fast becoming a component part of the automobile engine. One can be made that will serve the purpose and the cost will be only for the price of a small pet cock and a piece of tubing.

Two methods may be used in making



Small pet cock interposed in the manifold of an engine instead of a regular vapor plug

the connections for the air inlet at the pet cock. The first one shown is where the pet cock is turned into a tapped hole in the manifold body and the rod connects a handle on the dashboard. The second method calls for a piece of tubing to form a connecting piece from the manifold body to the pet cock where it is placed on the dashboard within easy reach of the driver. In the manufactured plug the operation is automatic; but the simply constructed device must be worked by hand. It is claimed that these plugs will reduce the carbon formation, give more mileage per gallon of fuel, more power and speed. When starting the engine or on a cold day close the cock. It works best when the engine is hot.—R. F. BECKER.

A Substitute Drafting-Rule Made from Ordinary Flat Rule

FIRST buy a common flat rule with a metal strip embedded in a slot running lengthwise of the rule. Next get a piece of cardboard the length and width of the rule. Glue this firmly to the underside of the rule. The cardboard raises the edge of the metal strip a trifle off the drawing paper, thereby allowing the ink from the drafting-pen to flow freely and without danger of smearing. Rulers like the one described are not expensive and when treated according to instructions will give as much satisfaction as a steel scale.

Succeeding in Radio Work

Advice to the Radio Amateur

THE future development of radio telegraphy is largely in the hands of the earnest non-professional experimenters of to-day. From the ranks of this country's 300,000 amateurs are to be recruited many of the men who will make wireless telegraphy of greater and greater public value in the years to come.

Amateurs have been handicapped by a lack of authoritative technical guidance. Much of the instruction given them has been and is entirely inaccurate.

The POPULAR SCIENCE MONTHLY, in accordance with its policy of expressing scientific facts truthfully and clearly, has arranged for a series of wireless articles of a new sort. In them some of the hardest problems of the radio amateur will be explained and solved by Mr. John L. Hogan, Jr., who has agreed to aid the POPULAR SCIENCE MONTHLY'S readers in this way. Mr. Hogan is Chairman of the Standardization Committee and Vice-President of the Institute of Radio Engineers, Honorary Member of the Radio Club of America, member of the American Institute of Electrical Engineers, and a Research Engineer. His inventions and scientific writings are widely known in the radio field throughout the world, and his views are authoritative. Best of all, however, he is able to explain abstruse scientific and engineering matters so simply and clearly that they can be grasped even by beginners in the study of wireless.

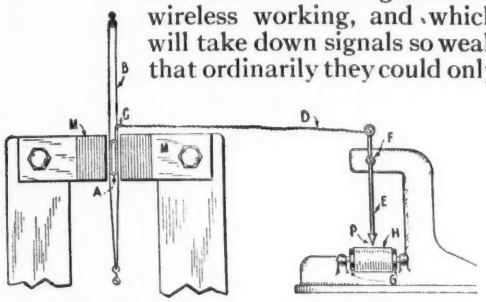
Mr. Hogan believes in the radio amateurs, and is going to help us help them. Watch for the series of articles, which will commence in an early issue of the POPULAR SCIENCE MONTHLY.

The Amateur Electrician

And Wireless Operator

Delicate Recorder for Wireless Telegraph Signals

PROF. TURPAIN, a prominent Parisian scientist, has been engaged for some time past on the subject of recording instruments for wireless waves, and has brought out a very sensitive recorder which is intended for long-distance wireless working, and which will take down signals so weak that ordinarily they could only



A sensitive recording device for receiving signals too weak to be heard in a receiver

be heard in the telephone. The device consists of a powerful permanent magnet *M* of the type used for ocean cable work, with a flat swinging coil *A*, mounted on the fiber suspension *B*. On the coil is a light arm *C* which connects by a thread *D* to the recording device, so that the slight movements of the coil will produce larger movements of the pen. The recorder consists of a swinging arm *E* which is pivoted at *F* in the usual way. The lower end of the arm carries the pen *P*. Under the pen, but without touching it, passes the paper band *H* mounted on the rollers *G*. The novel part of the invention consists in making the record without having the pen touch the paper, for this would cause too great a friction for the small amount of pull afforded by the swinging coil. The pen contains a volatile liquid, such as ammonia, and the vapors of this substance are made to act on a paper that is moistened with a suitable chemical preparation so that the ammonia vapor will produce a color upon the paper. Certain compounds of phenol can be used for this purpose. When the paper travels along and the pen operates, the signals will be recorded in a wavy line corresponding with Morse dots and dashes.

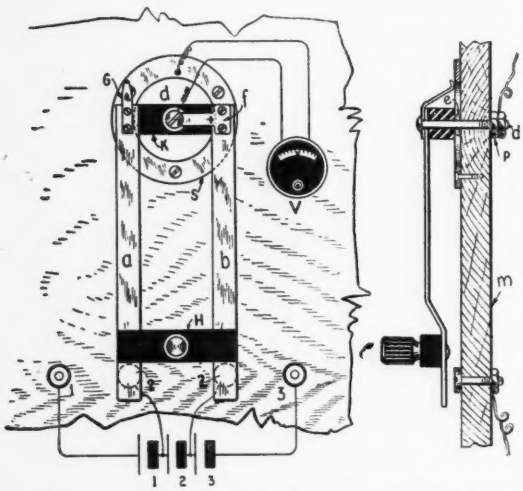
A Self-Contained Battery Lamp for Physicians' Use

THE illustration shows an improvement over the usual kind of battery lamps which physicians or surgeons use for examining the eye or the mouth. Generally the battery is carried in the pocket, but the flexible cords often become tangled. Besides, where a contact device is used for the lamp, the hands should be left free. In the device shown, the entire outfit is carried on the head and is self-contained. A suitable head-strap holds the battery-case, and the electric lamp is held very conveniently on the under side of the box. The lamp-holder with its lens is mounted so as to swing on a pivot, and a rack-pinion operated by a milled head provides a way to throw the beam up or down. A flexible cord leads to a spring contact which is carried in the mouth, so that contact can be made by the teeth for lighting the lamp. This device leaves the operator's hands entirely free and eliminates the bother encountered with the cords of the pocket lamp.

Battery and light strapped on forehead

A Handy Method for Voltage Testing of Storage Batteries

TESTING a battery of storage cells to determine whether or not they need recharging is a very difficult matter when the batteries are put in an out-of-the-way place not easy to reach. But in just such a case as this, the method described herein is particularly useful. A specially constructed



Wiring diagram for voltage testing each cell, and the cross-section of the switch connection

change-over switch is mounted on the same panel with the voltmeter. The switch contains two contact arms capable of being rotated in as many positions as there are batteries to be tested. The voltmeter is connected with the pivot-end of the switch and the individual cells are themselves connected with the contact-points surrounding this pivot. The contact arms or blades *A* and *B* are made of strips of spring brass or copper, and two small blocks of fiber, *H* and *K*, are fastened to them by machine screws to keep them apart. The rectangular arrangement so formed revolves about the larger machine screw *D*, which passes through a hole drilled in the center of the block *K* through a suitable washer *E*, finally into another hole in the panel *M*. The two nuts, *P*, hold the screw *D* in position and at the same time provide a means for attaching an electrical connection. The blade *B* is electrically connected with the screw *D* by means of the connecting strip *F*, as shown. The blade *A* makes another outside connection through the circular brass ring *S* and the brush *G* which touches it no matter in what position the blade happens to be. The connection with the ring *S* and the connection with the screw *D* lead to the respective terminals of an ordinary 1- to 3-volt voltmeter.

The contacts surrounding the pivot of the switch are made of machine screws and are spaced apart from each other a distance equal to the distance between the two blades *A* and *B*. This switch requires the number of contacts to be only one more than the number of cells that are connected in series. The connections are made with the contact-screws in the rear of the panel, and adjacent contacts are connected with adjacent posts on the cells, as shown in the diagram of connections. From this diagram it is evident that when the blades are in the position 1, the voltmeter will be connected with cell number 1. In the position 2 shown in the diagram, the voltmeter will be connected across cell number 2; and so on. Thus, in testing each cell, it is only necessary to turn the switch.

How to Handle Hard Rubber to Prevent Its Breaking

HARD rubber is one of the materials most frequently used by the electric experimenter; first because of its excellent insulating qualities, and second, because it is easier to handle than porcelain or similar hard materials. Nevertheless, a great deal of the material is often wasted before the desired results are accomplished, because care is not taken in the working of it.

Hard rubber can be cut without chipping, with a hacksaw or a fine-tooth saw if the cut is made more than half way through on one side, then started on the other side until the first cut is met. The pressure on the saw should be very light or the rubber will crack. Rubber can be drilled with ordinary twist drills in a drill-press; but the stock should be laid on a perfectly flat surface and a very light pressure applied on the drill. When finishing a base it is often desirable to have the edges rounded. This can be done with fine sandpaper. To obtain a dull finish on the surface it should first be sandpapered and then washed. A brighter finish can be obtained by mixing a little emery with oil and polishing the surface.

When working hard rubber in a drill-press it is best to have it fastened to a solid support so that the drill will not bend, or the material lift up with the turn of the tool.—ALEXANDER V. BOLLERER.

How to Become a Wireless Operator

VIII.—Tuning with the Variable Condenser in Primary and Secondary

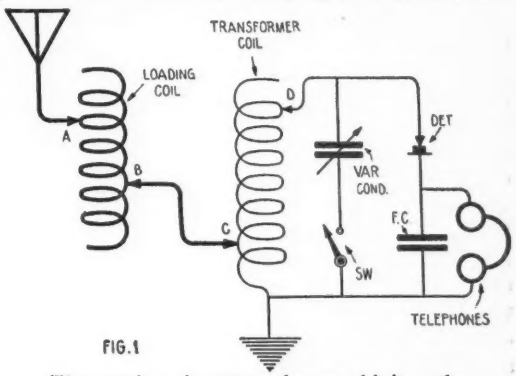
By T. M. Lewis

LAST month's article described in detail the construction of a simple variable condenser which could be built at home and which is entirely suitable for use in either the primary or secondary circuit of any normal radio receiving apparatus. It is the purpose of the present article to show how one or more of these variable condensers may be used to the greatest advantage, both for increasing sharpness of tuning (and thereby lessening interference difficulties) and for increasing signal strength. The great advantage which is secured immediately upon the use of a variable condenser is in the flexibility of circuit adjustment which can thus be secured. Practically all the effects of mere tuning to wavelength can be obtained from variable inductances alone, using fixed condensers. However, to change the ratio of inductance to capacity, which is one of the important factors governing sharpness of tuning, it is necessary that both the condensers and the coils be variable; if only one element can be altered, it is not possible to secure any desired ratio at any desired wavelength.

A second advantage gained by using variable condensers is the mechanical simplification of the inductance coils connected with them. Since the condensers are continuously adjustable, and can therefore be set at any desired value of capacity without the limitation of switchpoint steps, it is unnecessary to take out many coil taps in order to get close variation of inductance. Any wavelength can be tuned to with accuracy, with only a few steps or connections on each inductance coil, because the condenser fills in the tuning range.

Advantages of the Sharply Tuned Secondary

There has been some dispute as to whether a secondary tuning condenser, connected in the usual way, shown in Fig. 1 and 2, aids in producing a receiver more effective than the simple "broad tuned secondary" circuit. Extended trials have shown beyond a doubt that the sharply tuned circuit of Fig. 1 and 2, when properly adjusted, will give greater selectivity for the same strength signals than the circuit without variable condenser in the secondary. By building the secondaries specially to suit each case, about the same maximum signal strength may be had with both types. With the secondary variable condenser, however, the maximum signals are secured with looser coupling between primary and secondary. As a result, the tuning is sharper and interference is much reduced. The practical actions of such tuners as Fig. 1 and 2 represent should be studied in detail by every operator, and the differences in operation dependent upon closing and opening the condenser "switch" in the secondary circuit should be particularly noted.



The receiver is set up by combining the tuning coils with the variable condenser

The receiver of Fig. 1 is set up by combining the tuning coils described in the February article with the variable condenser of last month. The resulting arrangement is capable of excellent signal intensity and tuning sharpness. Although it is a directly or conductively connected auto-transformer type of receiver, it has variable coupling between primary and secondary, and is therefore not open to much of the criticism applicable to the ordinary "two-slide tuner" combinations. For the same reason it requires more careful handling in order to produce the best results.

In operating any of the tuners described, it must be borne in mind that the instruc-

tions of this article apply solely to the proper manipulation of the inductances and condensers. Before beginning to tune, the operator must have made sure that his connections are properly fastened, that his aerial and ground leads are correctly arranged, that the telephones are in good

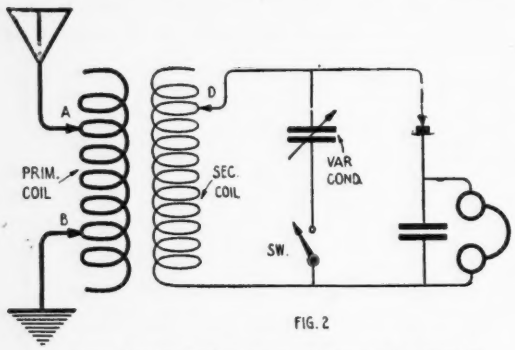


FIG. 2

The usual inductively coupled type of a receiver employed in the majority of wireless sets

condition and that the detector is adjusted to a sensitive point. The two last-named items are all-important. Each time the receiver is operated they should be tried out by a "test buzzer" equipment such as described in the December, 1916, article of this series. Once these preliminary steps are gone through, the entire attention may be devoted to tuning. Unless you are certain that the rest of the apparatus is in working order, however, much time and effort will be wasted in trying to build up signals by tuning alone.

Tuning the Coupled Receiver

The tuner of Fig. 1 has five tuning adjustments. The positions of switches *A*, *B* and *C* govern the wavelength to which the primary or antenna-to-ground circuit is tuned. The third adjustment (switch *C*) also determines the coupling between primary and secondary. The fourth switch *D*, and the secondary variable condenser, fix the wavelength to which the secondary is tuned. The more turns of loading coil included in circuit by the switches *A* and *B*, and the more turns of transformer coil cut in by switch *C*, the greater the tuned wavelength of the primary circuit. Also, the more turns cut in by switch *C*, the closer the coupling between primary and secondary and, consequently, the broader the tuning of the set. The more turns of the transformer coil cut into the secondary circuit by the switch *D*, and the greater the active capacity of the secondary variable condenser, the longer the tuned wavelength of the secondary circuit.

Having noted the effects of the various switches and the condenser, as above, and bearing in mind that the object of tuning is to get the primary tuned wavelength and the secondary tuned wavelength to be as nearly as possible equal to the wavelength being received, it is not hard to see how the various elements must be adjusted. There is an additional object, however, which complicates matters a little; that is, the coupling between primary and secondary must be made as loose as possible without sacrificing strength of signals. Since reducing the number of turns cut in by switch *C* loosens the coupling, it is clear that this switch must be kept as near to zero as possible without weakening the signals too greatly.

First Operations in Tuning

It is almost impossible to adjust the five variables to their best points simultaneously, so the best plan is to eliminate certain of them from the preliminary operations. In beginning to tune in a signal, therefore, open the switch which thus disconnects the secondary condenser. This gives the secondary a broadly tuned character, and makes it much easier to "pick up" a strange, incoming message. Next, cut in nearly all of the secondary inductance by setting switch *D* to a high value of turns. Since the secondary condenser is cut cut, this

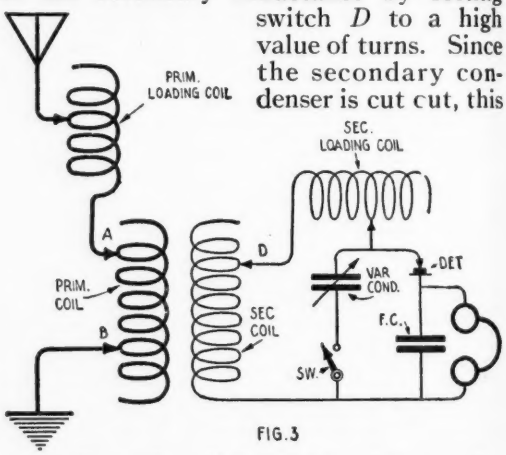


FIG. 3

Loading coils added to the primary and secondary circuits for tuning long waves

has the effect of bringing the secondary circuit more nearly in tune with the usual wavelengths than would be the case if fewer turns were used. Third, set the coupling switch at forty or fifty turns (unless the wavelength you expect to receive is very short, when fewer coupling turns will be

used) so as to make the coupling quite close and therefore to aid in hearing signals to which the apparatus is not accurately tuned. Fourth, set the single-turn switch *B* at the middle of its arc, and finally try to pick up your desired signals by moving the ten-turn step primary switch *A*. As

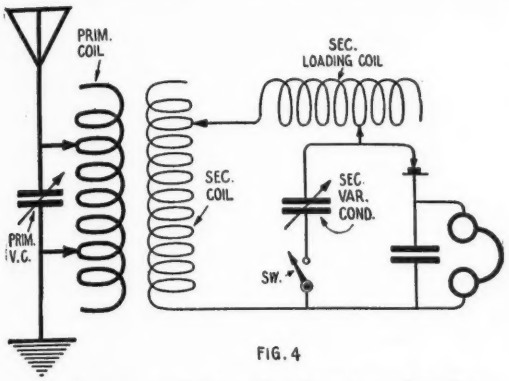


FIG. 4

Another way of procuring long wavelengths with a receiving transformer of medium size

soon as signals are heard, reduce the number of coupling turns by switch *C*, at the same time compensating for those cut out of the primary circuit by correspondingly increasing the turns of the loading coil. When the best settings of switches *A*, *B* and *C* are found (that is, the points upon which the signals are loudest), close the secondary condenser switch and set the secondary contact *D* to the button giving the loudest signal. Then adjust the condenser itself until the signals are loudest; and the receiver will be about at its best adjustment.

Further improvement in signal intensity can be secured by readjusting the primary single-turn switch, *B*, after the secondary is sharply tuned. Sometimes it is best to change the position of the coupling-switch *C* after the secondary condenser is cut in. All this must be determined by trial for each particular station heard. The important things to remember are, to make the rough primary adjustments first, the secondary adjustments second, the final coupling adjustments third, and to try both the primary single-turn switch *B* and the secondary condenser last, in order to make further improvement in signal strength or tuning sharpness, every time any other adjustment is changed.

The Inductively Coupled Receiver

The circuit of Fig. 2 is the usual inductively coupled type used in most receiving sets. It is entirely satisfactory for general receiving, but must be handled carefully in order to give the best results. Its manipulation corresponds very closely with that just set forth in detail for the auto-transformer tuner. The only radical difference is that coupling is changed by moving the primary coil physically with respect to the secondary. As before, the more turns of primary cut in between the single-turn switch *B* and the ten-turn switch *A*, the greater the tuned primary wavelength. Similarly, the more turns of secondary coil cut in by switch *D*, and the greater the active capacity of the variable condenser, the greater the secondary wavelength. Again, the farther apart the primary and secondary coils, the weaker (looser) the coupling between them and, consequently, the sharper the tuning and the less interference difficulties.

The objects of tuning are, as before, to adjust the primary and secondary tuned wavelengths to agree with that being received, while at the same time keeping the coupling as loose as possible without destroying the signals. The plan to follow, therefore, is to open the secondary condenser switch and cut in a large portion of the secondary coil as before. Then close the coupling by sliding the coils well together. Finally, search for the desired signals by making rough adjustments of the primary. When signals are heard, open the coupling by sliding the coils farther apart and at the same time adjust both the

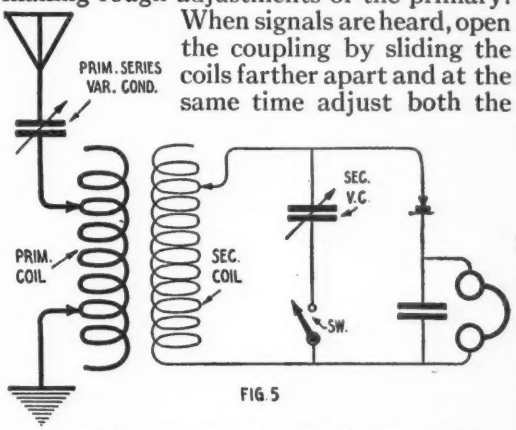


FIG. 5

A variable condenser inserted in series with the aerial connection for short wavelengths

primary switches to the point where signals are loudest. Then reduce the number of secondary turns and cut in the secondary condenser, setting these to the points which give best signals. For the last adjustment, open the coupling still further and tune the primary and secondary still more accurately. Always bear in mind that the three groups

of settings (primary, coupling and secondary) are physically interlinked and that whenever you change any of them you must try the single-turn primary switch and the secondary condenser in order to find out whether you are hearing the loudest possible signals.

In picking up very weak signals it is sometimes necessary to adjust the large primary and secondary steps together, since in that way the circuits are kept more nearly in tune all the time, and weaker signals can be heard. Under such conditions, it is evident that when few primary turns are in circuit the secondary switch must be near its zero point, and that as the number of primary turns is increased the number of secondary turns must be increased correspondingly. Such detailed handling of the apparatus can only be learned by experience, however, and for cases of this kind these instructions can do little more than suggest a line of action.

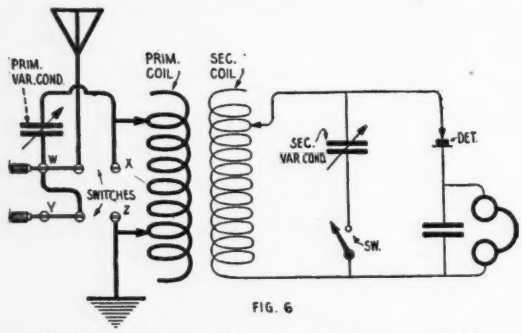


FIG. 6

A circuit with switches to connect variable condenser in series or shunt with primary

Receiving Long Waves

For tuning to very long waves it is sometimes necessary to add loading coils to primary and secondary circuits, as shown in Fig. 3. The addition of active turns to the primary of course increases its wavelength range; a similar effect is had in the secondary. The wavelength of the secondary circuit may be increased by enlarging the size of the secondary variable condenser, and when this is done the secondary loading coil is of course unnecessary. Nevertheless, it is a good plan to keep the inductance of the secondary large, and its condenser correspondingly small; the additional loading coil is therefore the preferred method of extending the tuning range to include the very longest waves. When the main transformer is very small and the received waves are exceeding long, it may not be possible to get close enough coupling unless the primary and secondary loading coils are placed near together so that they act as an additional transformer. When this is done, care must be taken that the direction of connection is correct; otherwise the inductive effect between the loading coils may neutralize instead of helping that between the original primary and secondary coils.

Another way of getting long wavelengths with a comparatively small receiving transformer is shown in Fig. 4. Here a second variable condenser is shunted across the primary coil terminals, which has somewhat the effect of increasing the capacity of the antenna. This arrangement has a number of advantages, among which is that by its use the fine tuning of the primary can be accomplished by varying the condenser, and that, as a result, it is unnecessary to build the primary coil with a single-turn witch. Further, and especially when very small receiving antennas are used, signals may be louder with this shunt primary condenser than when the same long wave is received by adding the primary loading coil. In Fig. 4 the secondary loading coil is shown, but, as before, its effect of increasing the tuned wavelength may be obtained by enlarging the secondary condenser.

Tuning to Short Waves

When it is desired to receive wavelengths which are short compared with the fundamental wavelength of the antenna, it is very convenient to insert a variable condenser in series with the aerial connection, as shown in Fig. 5. This has the effect of reducing the size of the receiving antenna, and makes tuning to short waves a very simple matter. As when the primary variable condenser was used in shunt (Fig. 4), small primary inductance steps are not needed, for the sharp tuning may be secured by means of the series condenser. With the arrangement of Fig. 5 it is also possible to tune to wavelengths of the medium range, since the inductance in series may be increased to give the period desired. When used in this way the signals are sometimes weaker than those obtained from the arrangement of Fig. 2, but the tuning is usually sharper, because the ratio of inductance to capacity is increased.

The primary circuit is shown in Fig. 6, which may be arranged with two single-pole double-throw knife switches so as to connect the variable condenser in series or in shunt with the primary, or to cut it out

altogether. With both switchblades at the left, in positions *W* and *Y*, the condenser is in series, as shown in Fig. 5. When both switchblades are thrown to the right, in positions *X* and Z, the condenser is in shunt to the primary coil, as in Fig. 4. When the upper switchblade is at the right and the lower at the left, i.e., in positions *X* and *Y*, the variable condenser is cut out and the circuits are connected as shown in Fig. 2. This same switching arrangement may also be used with the autotransformer arrangement of Fig. 1. Practically the same results will be secured, except that the primary turns are changed whenever the switch *C* (Fig. 1) is moved to vary the coupling.

Experienced radio operators, as well as beginners, will find it worth while to study the principles explained in this article. They are the basis of successful operation of the coupled receiving sets.

(*The end*)

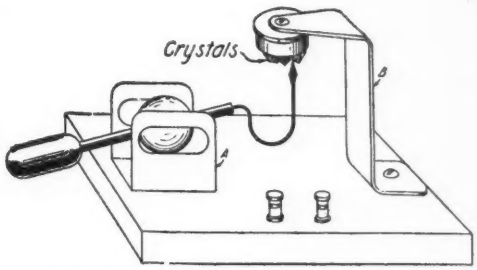
Power Measurement Method Without a Watt-Meter

MANY amateur electricians would like to know the power consumption of devices they construct, but do not have access to a watt-meter. The watts consumed may be found as follows: Turn off all lights in the house except one of known power consumption, and count the number of seconds required for the watt-hour meter's disk to make one revolution. Then turn out all lights, connect into the circuit the device whose power consumption you desire to know, and again count the number of seconds for the meter disk to make one revolution.

To find the power consumed by the device, multiply the watts of the lamp by the number of seconds required for a revolution of the meter disk when connected and divide by the number of seconds required for a disk revolution with the device itself connected. For example, one meter required 30 seconds for one disk revolution with a 25-watt lamp connected, and 60 seconds with a small transformer furnishing current to a small motor connected with it. The power consumption of the transformer and motor was thus $25 \times 30 \div 60 = 12.5$ watts. If the disk runs so fast that it is difficult to time it for one revolution, the time for a greater number of revolutions should be taken, the number being the same with the device tested as with the lamp.

An Easily Constructed Detector-Stand for Wireless Instruments

A DETECTOR-STAND can be easily made from a few simple materials. Procure a piece of brass 1/16 in. thick, and cut it into the shape shown at *A*. The openings may be made by drilling holes and

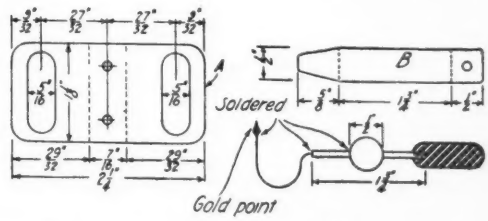


A detector-stand which can be easily made by the amateur from a few simple materials

filing the edges. Bend the brass on the dotted lines so that a U-shaped piece is formed with the slots parallel.

Obtain a brass or copper ball ½ in. in diameter, and drill a hole through it to admit a brass rod 1¾ in. long. Thread one end of the rod to fit the insulating knob. Solder the ball and a piece of fine brass wire on to the rod, as shown at *C*. The point of a gold scarf-pin may be soldered on to the end of the wire to serve as a "cat-whisker." It is easily adjusted.

The standard *B* is heavy brass, bent on the dotted lines. The cup, with the crystal, is fastened to it with a screw as shown. The inverted position of the crystal prevents dust from settling on it and maintains its sensitiveness. The base may be made of

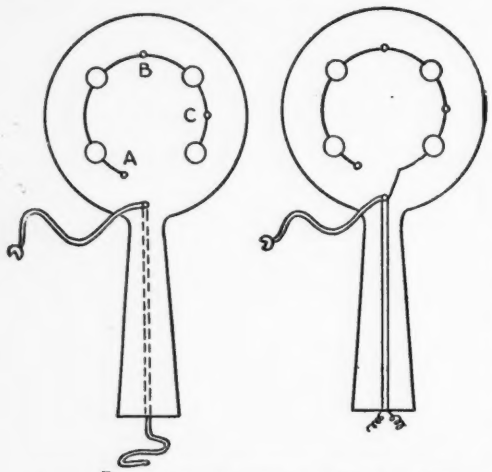


Construction diagram of the home-made detector-stand showing dimensions

hard rubber or any hard wood. Be sure that the uprights of the piece *A* are just tight enough to hold the ball in place. The knob can be moved backward or forward, or in any direction desired to secure the best crystal setting.—G. F. EXNER.

An Inexpensive Tester for an Electric Lamp

THE drawings show how to rig up an inexpensive tester for lamps for use on 110, 220 or 440-volt lines. First cut a board as shown in the first sketch, making it about 8 in. in diameter, with a handle long enough for a good grip.



Lamp sockets on a board cut like a paddle for testing lamps of different voltage

Then locate four lamp-sockets as shown. If the upper end of the sockets are tapped for a ⅜ in. pipe, cut nipples long enough to reach through the board. These hold the sockets in place.

Binding-posts are located at *A*, *B* and *C*. A hole is bored through the handle of the tester, large enough for the lamp cord and connections, as shown.

The tester may be changed to receive current from any of the three different voltages, by simply attaching the loose end to the different binding-posts, according to the voltage of the current. In brief: Attaching the end to *A* makes a circuit for 440 volts, to *B*, for 220 volts, and to *C*, for 110 volts. New globes are used in the tester, and the lamp to be tested is placed in the last socket on its circuit.

An Emergency Electric Plug Made of Broken Lamp

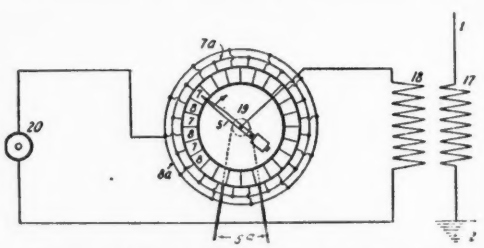
WHEN the extension plug to the Christmas tree lighting outfit was left loose on the floor, and was kicked into the open grate fire, an emergency plug had to be made in order to hold the celebration according to schedule.

An old fuse plug was used for this purpose. One wire was soldered to the shell and the other to the brass stud in the center. A disk of fiber with holes for the wires was substituted for the mica. This made a good and serviceable plug, which has been used several times for other purposes.—AARON E. SMITH.

A Mechanical Rectifier as a Wireless Receiver

IT is well known that the power of the high frequency current set up in a receiving antenna, by the arrival of normally strong waves, is much more than enough to operate a telephone receiver. There is no need of amplifying the effects of this received energy; it is merely necessary to convert it into a form which is suitable for the operation of a telephone or other ordinary indicator. Since the radio frequency current itself is too high to cause energetic response of the regular magnetic telephone, the conversion need be merely a reduction in frequency; as an alternative, the energy may be rectified into pulsating direct current.

The crystal rectifiers which are used in so many stations serve to distort the current of the received waves so that, as it reaches the telephone, it is stronger in one direction than in the other. Thus for each group of waves the diaphragm is attracted or repelled (according to the polarity of the current pulse) a single time. If sustained waves are received it is necessary to break them



By changing the speed of the interrupter a musical signal of any pitch can be secured

up into groups, in addition to rectifying them as just described, if tonal signals are desired. The groups may, for example, be secured through methods involving interrupters, or "beats" production.

There is no need of any rectifying crystal or other complex conducting system if the incoming oscillations are passed through a high-speed commutator. The tone-wheel, formerly used at the Tuckerton Transatlantic Station, is an apparatus whose operation has been described as mechanical rectification. A nearly identical device is shown in U. S. Patent 1,172,017, which was applied for by R. A. Fessenden in 1906 and was issued during the past year. The drawing indicates an antenna 1 connected to earth 2 through a primary inductance 17, which serves both to tune the aerial system and to couple that circuit with the secondary coil 18. The upper terminal of 18 leads to a rotating contact arm 5 which passes at high speed over segments 7, 8 of a large commutator. The lower secondary connection is taken through a telephone 20 and the wire 37 to the group of alternate segments marked 8 and connected together through 8a.

If the brush 5 is rotated at a high rate it is possible to secure synchronism between the time of contact and the alternations of the received-wave currents. By arranging matters so that the rotating contactor rests upon a segment of the No. 7 group during each negative half-wave of received current and upon a No. 8 segment throughout each positive half-wave, a positive direct current will flow through the telephone whenever waves are received. Thus the system acts mechanically to convert the radio-frequency alternating current into direct current suitable for producing telephonic effects if interrupted. As shown in the diagram, only one-half of the wave-current is used; by connecting another ear-piece, such as 20, to the remaining group of segments (No. 7) and carrying the circuit to the lower end of 18, both halves will be made effective.

When receiving sustained waves it is merely necessary to run the commutating contact at a speed slightly different from synchronism, if a musical note is desired. The interruptions then gradually change in relation to the half-waves, so that for a time the rectification is positive and then for a time negative. The rapidity of change of rectification polarity depends upon the difference between the interruption frequency and that of the waves.

Making an Inclosed Rotary Spark Gap

SEVERAL enclosed gaps such as are herein described have been made by the writer and have not only proved very efficient but also have reduced the noise of the spark a great deal.

The dimensions given in this article

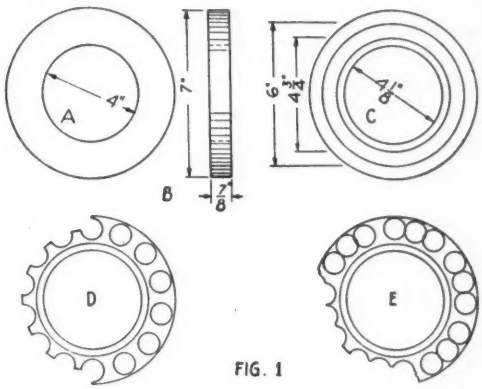


FIG. 1

The rotor is made from an aluminum zinc combination casting to prevent wearing

are of course applicable only to one size motor and may have to be changed. If the amateur has no motor, one of about 1/10 horsepower, which is either induction or series wound, should be procured, as this power will allow for a larger and more accurate rotor. If an induction motor is used, the number of points or lugs on the rotor should be such that it will give a frequency of any odd multiple of 120, such as 360, 600, 840 or 1080 sparks per second. This will give a clear note or 60 cycles without any undertone.

The rotor (Fig. 1), is made from an aluminum zinc combination casting, as

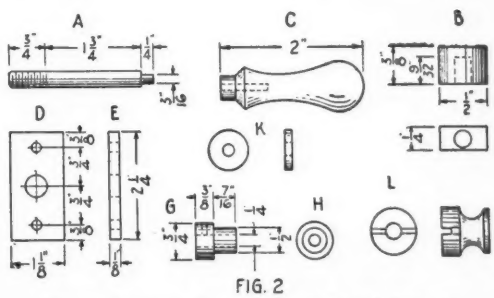


FIG. 2

Dimensions of the parts required for attaching the handles to the spark-gap frame

this will not wear away very fast and is easy to work. Pure copper can also be used if one has a motor of 1/8 horse-

power or more. The pattern for the casting should be about 7⅛ in. in diameter by ⅞ in. thick and have an inside diameter of 4 in.

The casting should be faced off in a large chuck as shown at *A*, *B* and *C*, Fig. 1, and have two circles marked on it of 4¾ in. and 6-in. diameter. If the constructor has not a large chuck the

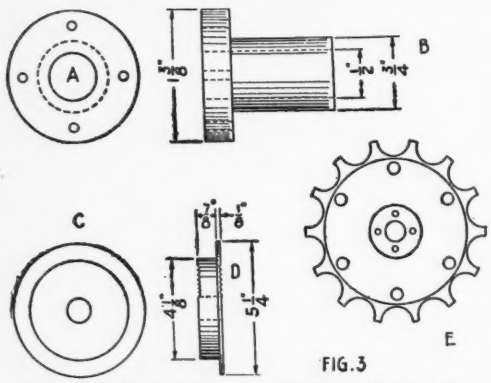


FIG. 3

Dimensions of the hub for the rotor which may be made of brass or machine steel

casting may be turned up by screwing it to a flat piece of wood. To do this one must drill about four holes in the casting, countersinking them 1/16 in. below the surface near the outer edges, and fastening to the wooden plate with wood screws.

After the casting has been turned to size it should be removed from the lathe and distances stepped off around the 6 in. circle according to the number of lugs desired. The plate or casting should then be drilled so that lugs ¼ in. wide in circumference are formed as shown at *D*. When only a few lugs are required for the gap, as when used on a high speed motor, it may be necessary to drill several holes together as at *E*. There should also be six holes drilled with a No. 28-in. drill at points equidistant on the 4¾-in. circle. These are to be tapped out for an 8-32 thread. When this is done the casting should be cut with a hacksaw through the remainder of the 6-in. circle, thus giving the rotor shape roughly. It will be found that if before drilling with the 1-in. drill a small drill about 1/16 in. in diameter is run through, the 1-in. drill will not slip out of place.

For highest radiation it will be found that some frequency between 300 and 800 works best, although the higher notes are more easily read through static.

There should be two pieces made of each part shown in Fig. 2 and (except for the handles *C*) they should be made of copper. Brass will do, however, except for the sparking surface *B*. The part *A* is made of ¼-in. round rod about 2¾ in. long threaded on one end for about ¾ in. with a 14-20 die and having a shoulder about 3/16 in. in diameter and ¼ in. long on the other end. The parts shown at *B* are the electrode tips which are made of copper ¼ by ½ by ⅜ in. drilled 9/32 in. deep on the side with a 3/16-in. drill. These last pieces may be soldered on the pieces *A* or may be driven on and secured with a small brass pin. The handles shown at *C* are about 2 in. long and may be made of black fiber, or wood painted black. Small switch handles, such as are used on 30 amp. 110-volt switches, may be used. The handles should have a 7/32-in. hole drilled in them 1 in. deep.

The parts shown at *D* are made from ⅛ by 1⅛-in. copper, 2¼ in. long drilled as shown, two holes with a No. 10 drill about ⅜ in. from the edges and a ½-in. hole in the center to fit parts shown at *G*. These pieces are made of ¾-in. round rod and are drilled through with a ¼-in. drill. There is a No. 21 drill hole for a 10–32 set screw at the larger end. These pieces should be

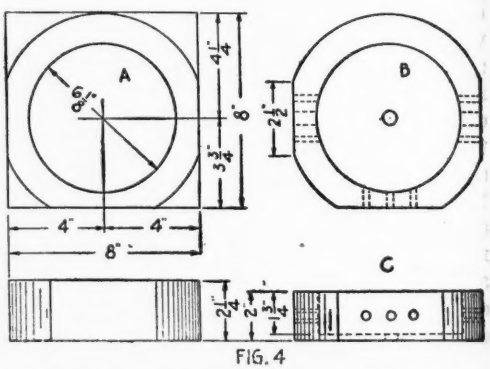


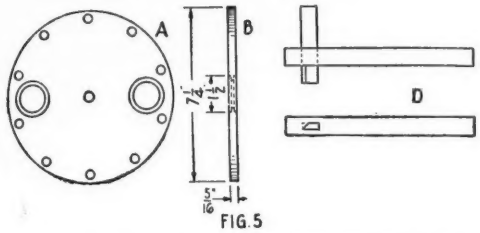
FIG. 4

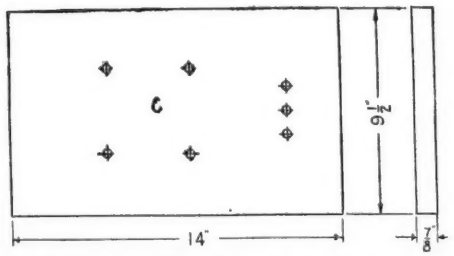
A hardwood block of oak or maple is turned to the dimensions for the frame

soldered into the center of the parts *D*. Instead of the pieces shown at *K*, 10-24 hex nuts may be used of a large size so as to look well with the thumb nuts shown at *L*.

In Fig. 3, *A-B* is the hub for the rotor, which may be made of brass or machine steel, 1⅜ in. in diameter. The

four small holes should be drilled with a No. 21 drill and threaded 10/32 and the center hole should be the size of the motor shaft. The insulating bushing between the hub and the rotor casting is





The cover for the casing is of black sheet fiber and is screwed on like a cylinder head

made of black fiber 5¼ in. in diameter and turned as shown. It will be found worth while to corrugate the sides with a round nose tool as shown at *D*, as this reduces surface leakage and improves the appearance of the rotor. The fiber piece should have No. 18 drill holes in it to correspond with those on the 4¾ in. circle of the casting *C*. There should also be No. 10 drill holes at the center corresponding to those in the hub. The rotor may then be assembled with round head screws and balanced. This may be done by putting a small piece of rod the size of the shaft in the hub and fastening it securely with the set screw. It should then be rested on parallel knife edges and drilled out at various points on the back toward the inner edge of the casting until it will rest at any position. The knife edges must be set absolutely level.

The wooden block shown in Fig. 4 is of quartered oak or maple and is 2¼ by 8 by 8 in. This block should be planed absolutely square. If it is turned off center as shown, the casing will be more accurate than if the block were turned and then the three sides cut off. The block should be hollowed out 6⅛ in. in diameter and 1¾ in. deep and drilled as shown in the illustrations.

The holes in the bottom of the block are for mounting it on the base, Fig. 5. *C*, and a center hole about 3/16 in. in diameter should be drilled for a 3/16-in. flat head bolt, and 1/16 in. on each side of it to receive a wood screw from the base. The three holes in each side should correspond to those in electrode plates. (Fig. 2, *D. E.*)

The fiber cover for the casing is shown at *A-B*, Fig. 5 and is made from 5/16-in. black fiber sheet. The small hole around the periphery should be 5/16 in. in from the edge and drilled with a No. 18 drill to allow the use of about ¾-in. round head brass wood screws to fasten cover to wooden casing. The large holes shown are for small circular windows to observe the spark and for adjustments.

For glasses, the lenses of the cheap grade of automobile goggles may be used by cutting all the metal away except a small rim around the glass. If you have not a drill of the proper size one can be improvised, as shown at *D*, by taking a piece of ⅜-in. machine steel with a rectangular hole cut through it and a piece of hardened tool steel about ¼ by ⅛ in. driven in and ground to a cutting edge. When using a drill of this sort, a hole the size of the machine steel—⅜ in.—will have to be drilled through the cover. Drill about 1/16 in.

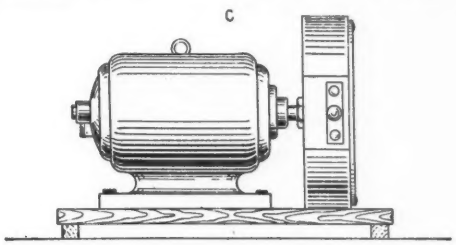
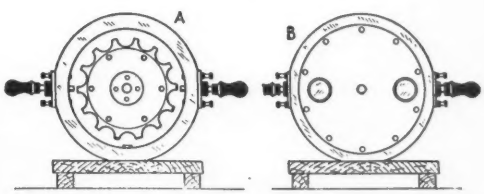


FIG. 6



Three views of the gap, as it is attached to the motor and the front and back sides

deep on each side of each hole the exact size of the glasses and then grind off the drill about 1/16 in. on the radius and continue the hole through. The glasses

may be glued in place and should be double, one inside and one outside of each hole. The base shown at *C*, Fig. 5, is made of ⅞-in. or 1-in. quartered oak stained and waxed, and drilled as shown to correspond to the motor base and gap casing. For assembling there will be needed four round head brass screws to fit the thumb nuts of Fig. 2, 2 flat head wood screws about 1½ in. long, one 3/16-in. iron machine screw about 1¾ in. long having flat head and a nut and washer, and a dozen ⅞ in. or ¾ in. round head brass wood screws.

In Fig. 6 are seen three views of the complete gap. The wood block should be mounted on the base by means of the 1½-in. wood screws and the 3/16-in. bolt, the flat head being on the inside of the block. Then the motor should be mounted in place on the base, with its shaft extending into the casing. The electrode bushings should be put in place on the sides as shown, using the 4 screws whose heads may need to be filed flat to about 1/32 in. thickness, and the thumb nuts and hexagon, or round nuts, as binding posts.

The electrodes may then be placed in the bushings and the wooden handles put on. Last of all, the rotor should be firmly fastened on the motor shaft with its set screw and the fiber front should be screwed on with the ⅞-in. round head brass screws. (*B*, Fig. 6.) Then the gap is complete.

To insure the desk or table top against any slight vibration arising from the motor, blocks 1 in. square of sponge rubber should be placed under each corner of the base.

Before starting the gap be sure to have the electrodes fastened in the proper places with the set screws in the bushings. The gap described here is sufficiently large for a 1-kilowatt outfit using 10,000 to 20,000 volts. If the constructor has access to a milling machine the casting can be much smaller; but the method shown in Fig. 1 will give satisfaction.

A Simple Method of Measuring Capacity of an Antenna

REFERRING to the diagram of connections, it will be seen that *E* is a buzzer; *F*, one or two dry cells and *I* a crystal detector. *J* represents the telephones; *G* is a variable condenser of known values (i. e., calibrated) and *H* is the condenser which is to be calibrated and whose capacity is unknown. *A*, *B*, *C*, *D* are four equal inductances as described below.

This method comes within the scope of material and instruments which the average experimenter has on hand, and is also very accurate.

The detector, buzzer and telephones are of any of the familiar types. The

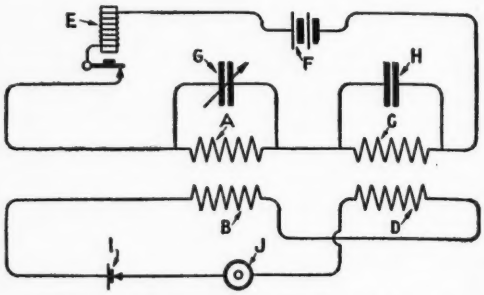


Diagram of connections for the apparatus to measure capacity of antenna wires

inductance coils should be made by winding four separate and similar coils.

Each one is to be made as follows, or as nearly so as may be convenient with the wire, tubes, etc., on hand.

Upon cardboard tubes 2 in. in diam. and 1¾ in. wide, wind twenty-five turns of No. 22 single copper-covered wire. Coils *B* and *D* are to be connected in the opposite direction to the winding on coils *A* and *C*, so that the two circuits will be opposed.

After connecting in the condenser *G* to be measured, turn the handle of variable condenser *G* until no signals are heard in the telephones. Then the capacity of *H* will be equal to the capacity of *G*, which of course must be ascertained from the calibration curve sheet. The operation should be performed very slowly as the "no signal" point is very sharp and it is very easy to pass over it.

In ordinary operation the coils *A* and *C* should be kept at least 3 or 4 in. from coils *B* and *D*, so that the coupling will not be too close. It will be noticed that on all other points of condenser *G* a continuous signal will be heard from the buzzer.

A calibrated condenser covering a range from .0002 to .0025 or even .003 microfarads is a good size to have.

This method can be used nicely for finding the capacity of an antenna if the ground and aerial leads are placed across inductance *C* in just the same manner as when connecting a condenser to be measured.

If it is found that no zero-signal point can be found by varying *G*, try reversing the connections of one of the coils (*D*, for example). If still no zero-point is found, the condenser *G* is probably of different value (throughout its range) than condenser *H*. To get silence in the telephones when the condensers are equal, the coupling of *A* to *B* should be the same as that of *C* to *D*; otherwise there will be only a reduction of sound at the balancing point.

How to Make an Experimental Dictograph

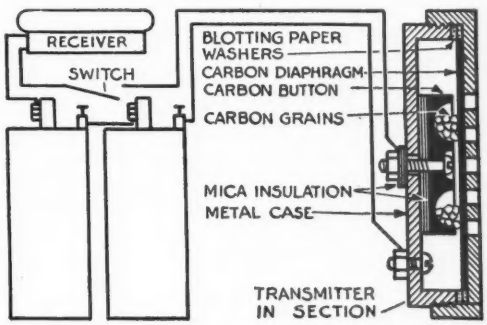
THE word dictograph is a trade name used to designate one make of telephonic instrument for receiving, transmitting and magnifying sounds. In a compact form it may be concealed and used in various kinds of detective work, conveying to the waiting listener, unknown to the suspected person, what is being said.

Such an instrument can be easily made by any one having even a small amount of knowledge of electricity. All instruments of this class are a combination of a telephone receiver with some form of a microphone, which is used as a transmitter. Such an instrument consists of a cell of granular carbon between two carbon electrodes. The back electrode is fixed, while the front electrode is carried on a thin iron diaphragm. The carbon disks and the granular carbon held between them constitute a powerful microphone. On account of the weight of the iron diaphragm and the electrode attached to it the inertia of these parts is comparatively great so that it is not affected by very faint vibrations, and to transmit the voice properly the person using it must be close to the transmitter. To make a microphone useful for the dictograph it must be so sensitive that it will reproduce the voice when the speaker is a distance away. This may be accomplished by using a microphone in which the only moving part is a light carbon diaphragm. An instrument of this type is shown in detail in the illustration.

A carbon button containing on one face a number of depressions is held near a carbon diaphragm. The button forms one electrode and the diaphragm the other. The current flows from the button to the diaphragm through the granular carbon which half fills each depression in the button. The atmospheric vibration set up by the voice causes motion of the carbon diaphragm which is transmitted to the granular carbon, increasing or decreasing the pressure of the carbon grains against each other, and causing variations in the current that will reproduce in the receiver the sound of the voice which caused the vibrations.

A transmitter of this general type, together with a telephone receiver, a switch, and two battery cells, connected as shown, are the essential parts of all instruments of the dictograph type, as well as for all telephonic aids to the deaf, any one of which may be used as a dictograph by employing leads of proper length to allow the instrument to be placed as desired.

The experimenter can find the parts necessary for making the transmitter listed in catalogues of electrical supply houses — carbon backs, carbon diaphragms and grain carbon. In making the transmitter care must be taken to place the diaphragm so that it does not touch the carbon back and still is close enough to prevent carbon grains from



Connections for the battery circuit and a cross section of the transmitter

getting between the diaphragm and the carbon back.

The transmitter must be held in a vertical position, or the grain carbon will not lie against both the diaphragm and the carbon back. A switch is provided for opening the circuit.

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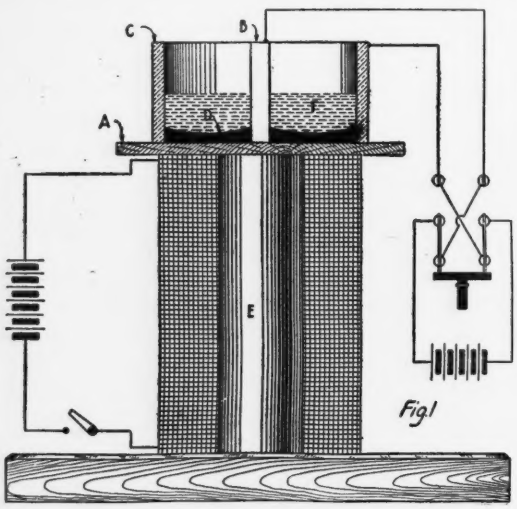
Electromagnetic Rotation of an Electrolyte

THE following interesting experiments may be performed by anyone possessing an electromagnet. The apparatus used is very simple and is shown in Fig. 1. The base *A* is a cardboard about 2 in. in diameter and *B* is a ¼-in. brass tube placed in the center of the cardboard. A



A brass cylinder is fastened with sealing wax on top of a magnet and holds the electrolyte

brass cylinder *C*, 1½ in. to 2 in. in diameter, is placed upon the cardboard. The sealing wax *D* is placed in the bottom to secure the cylinders and protect the cardboard. It should be slightly concave, as shown, for the mercury experiment. The part represented by *E* is an electromagnet. In its stead the primary of an induction coil, or a strong permanent magnet may be used, if an electromagnet is not available. The electromagnet should be connected with a suitable source of direct current.

A connection is soldered to the brass cylinder at a point on its outer circumference and a connection soldered to the tube *B*. These leads are connected with one side of a reversing switch, as shown, the battery being connected with the center.

For the first experiment a fairly concentrated solution of potassium hydroxide (KOH), or sodium hydroxide (NaOH), may be used for the electrolyte.

Now, if the field is excited and the reversing switch closed, the electrolyte will rotate about the tube in one direction. If either the direction of the current or the polarity of the magnetic field be reversed, but not both, the direction of rotation of the electrolyte will be reversed also.

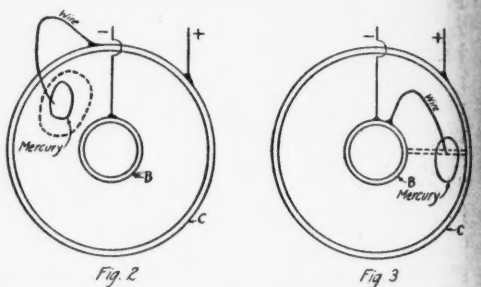
If a drop of phenolpthalein is allowed to fall into the solution when it is in motion, it will give it a striated or lined appearance.

If the strength of the magnetic field or the current passing through the electrolyte be increased, the speed of rotation is also increased, and vice versa.

In Fig. 2, a globule of mercury (Hg) was placed in the solution, and one end of a wire from the outer cylinder was brought in contact with the mercury, the outer cylinder being positive and the tube charged negatively. The mercury was flattened out considerably.

In Fig. 3, a wire is connected with the tube instead of the cylinder. When placed in the mercury, it will stretch out in a straight line from the tube to the cylinder. The phenomena of the mercury will take place without the magnetic field. If, however, the field is applied, the center of the mercury will be convexed in the direction of rotation of the liquid.

Sulphuric acid (H_2SO_4) may be used as the electrolyte if a carbon cylinder and rod are used. If a metal were to be used, the acid would attack it, and the fumes given off would drive the experimenter beyond the range of observation. This arrangement, however, will work better than the hydroxide solutions.



Manner of applying the current to the electrolyte for making the experiments

The pole that is charged positively attracts the negative ions and vice versa. Thus H_2SO_4, when ionized, splits up into the positive ion H_2, and the negative ion SO_4. These ions would move radially toward the opposite pole, if there were no magnetic field applied. Upon the application of a vertical magnetic field, the ions will be given a circumferential component of motion. The circumferential component of the viscous drag exerted by the moving ions forces the electrolyte to revolve.